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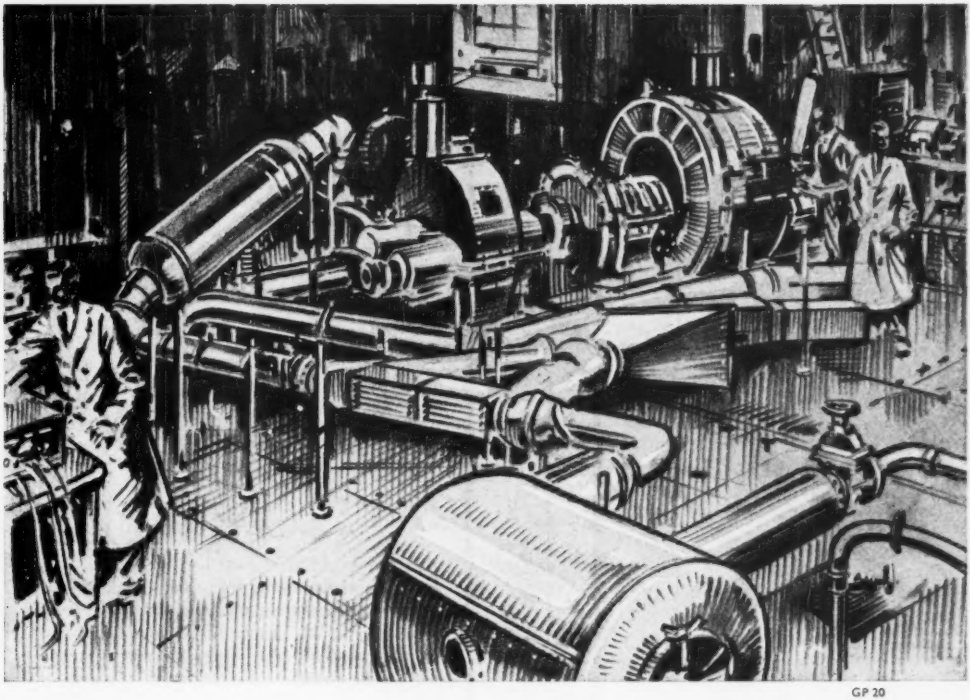

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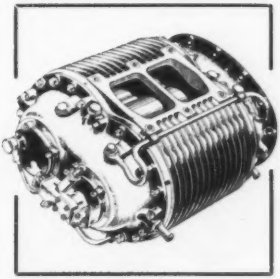

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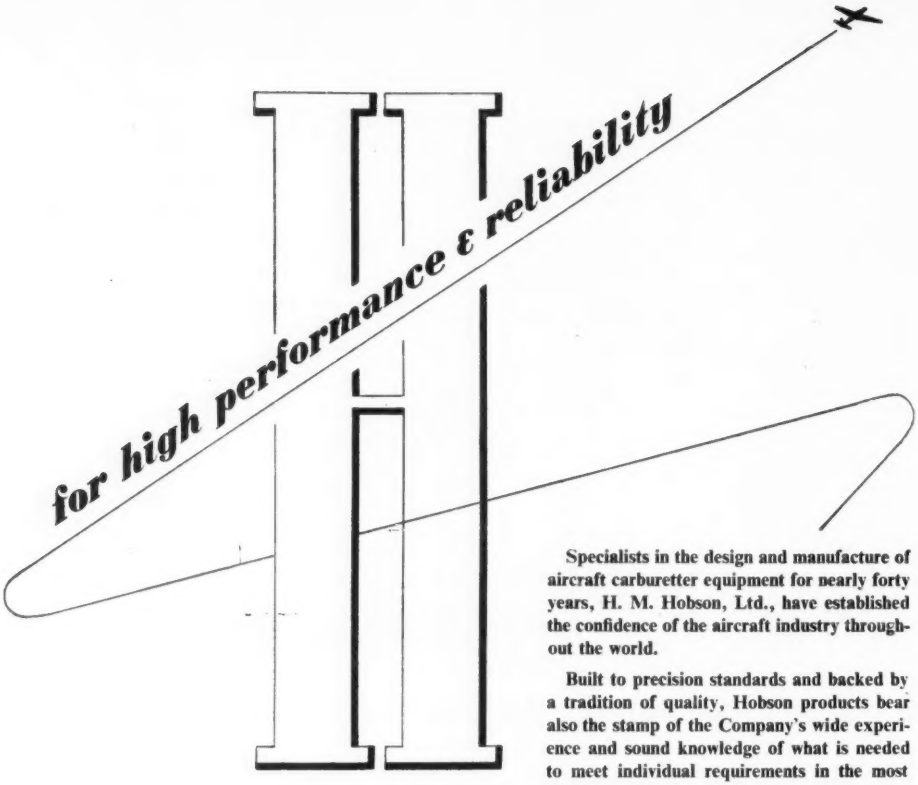

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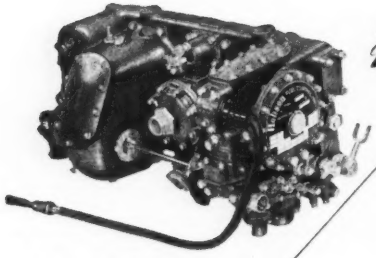

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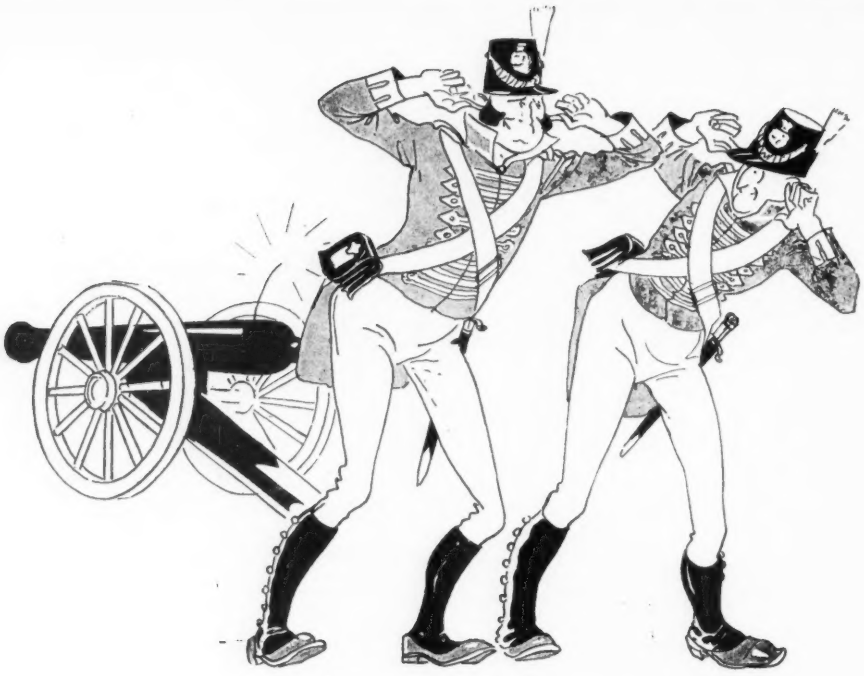

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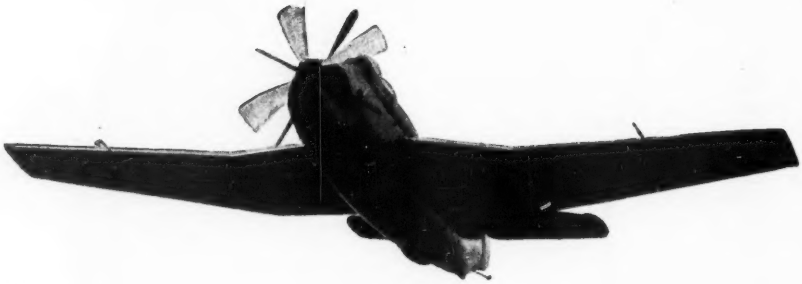

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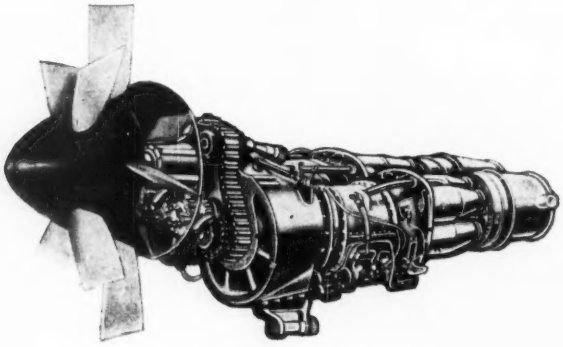

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Turning-Point

AT the turn of the year it is customary to review the achievements of the past twelve months and consider what may lie ahead. But at the present time, because we believe that the British aircraft industry may have reached a turning-point, we do not propose to refer to the subject in the conventional manner; nor shall we add to recently expressed views on the production of military aircraft.

Since the war ended, the industry has been battling with a series of problems, none of which was of its own making. Progress has been slow, and there have been a number of serious set-backs; but we have now reached a position at which, if the right decisions are taken—and in the main they are decisions for the Government—the development and prosperity of this vital industry will be profoundly influenced for many years to come and, in all probability, the well-being of the country materially affected.

In past centuries Britain built fine ships, as she does today, and no nation built better or knew better how to sail them. There are most excellent reasons for the country's traditional dependence upon the Senior Service and its essential complement, the Merchant Navy. But what of her position *vis-à-vis* the world's merchant air services, now on the threshold of unprecedented development?

America has provided the majority of the aircraft operated by the world's airlines today and is still producing them in relatively large numbers. Once a market is captured by a product which is good for eight to ten years and requires extensive spares and service provisioning, it is very difficult to dislodge the manufacturers who have secured that hold. The advent of the gas-turbine airliner has given Britain an ideal opportunity to regain a position lost during the war through no fault of her own. In this entirely new and all-important class of transport our industry has established a clear lead, measurable not in months but in years. Shall we be able to take advantage of it—or, in coloquial parlance, to cash in? If we can, there is a good chance of the country's standing in world aviation being bettered for at least ten years to come.

The answer depends entirely upon productive capacity, for if reasonable and reliable delivery dates can be quoted there is little doubt that orders of embarrassing proportions will be forthcoming to progress alongside those already placed (and falling behind schedule) for military aircraft.

Men must have Homes

We have referred on several occasions to the machine-tool and material problems which the industry faces, but not until all machines are double- or triple-shifted, as they were during the war, and until other non-essential industries are beginning to feel real material shortages because aviation is claiming so much, will these matters take the highest priority. At this moment housing comes first; recruitment figures for the aircraft industry usually omit to make mention of the good men who turn away because there are no homes for them and of others who leave a job they like solely because of unsatisfactory living conditions. If the Government does not face up to housing problems such as these, no worth-while increase in the labour force is likely to take place. When there is accommodation for them, there are practical means by which men can be attracted to the interesting work of building aircraft; and we would add here the opinion that direction of labour would be deplorable except in the case of outright war.

In times like these we should concentrate on those products—if need be, to the exclusion of others—in which our particular skill as a nation brings the biggest returns, and aviation is certainly one of them. Watches and clocks have made Switzerland prosperous, and these represent the application of natural aptitude to a few tons of brass. Britain should be earning foreign currency at the rate of £8 to £10 per pound weight of Comet, and gaining the accompanying prestige arising from ten years' employment of another British jet airliner on world air routes. By comparison, British cars sent abroad bring on an average only £1 per three pounds weight of material, a large proportion of which is precious steel, while other industries, in which we do not excel, and which exist upon world shortages, not only use up our resources inefficiently but bring us no credit.

EXPLOSION SUPPRESSION

A Protective Measure of Singular Promise and Unfortunate History

By The TECHNICAL EDITOR

TWO years ago, in our report of the 1949 S.B.A.C. Show, we made first mention of the Graviner explosion suppression system. Since that date, we have been unable to amplify details of the system because of "security." Recently, however, Mr. Jack Isreeli, of Simmonds Aerocessories, Inc., disclosed the essential details in a paper presented at the S.A.E. National Meeting at Los Angeles. We accordingly applied to the Ministry for permission to deal with the subject and were given clearance. In following up, it became apparent that, aside from laboratory work in developing the two main units of the system, virtually nothing has been done during the intervening two years. As we understand it, the story is as follows.

Whilst conducting research work into the chemistry of fuel explosion, Mr. W. G. Glendinning and Mr. A. M. McLennan, of the Royal Aircraft Establishment, found that the pressure development of a fuel-tank explosion was relatively slow in the early stages. This led them to reason that, if the initial generation of an explosion could be detected sufficiently quickly, it was conceivably possible that means could be devised for quelling the explosion before it had time to develop to destructive powers. They conducted experiments to such an end, and proved that explosion-suppression was, indeed, possible.

As a result, the invention—as is common with inventions by Government servants—was patented by the Ministry and thereafter, on invitation, the Graviner Manufacturing Co., Ltd., undertook development of the essential components of the system under joint M.O.S.-Graviner patents.

Part of the trouble lies in the fact that Graviners did not seek a development contract, but treated the job as a private venture. Thus the Ministry were easily absolved from the responsibility of arranging design studies and trial installations. These things take time, and someone has to pay for them; the aircraft constructor is altruistic only up to a certain point and, failing official direction, cannot be expected to devote design and construction manhours (for which he is hard-pressed anyway) to jobs which, however interesting and worthy they might be, are not *primarily* his concern. On the other hand, Graviners have neither the facilities nor experience to carry out an installation design study themselves; they are fire-protection specialists, not aircraft designers. So one is forced to the conclusion that even if the Ministry is freed from actual responsibility, it cannot be absolved from the moral responsibility for having done so little about explosion suppression.

If there were alternative systems which offered comparable immediate protection, the Ministry's case would leave less ground for criticism: as it is, the nitrogen system has been in existence since 1938 and, even in its latest form, has severe limitations which preclude its giving 100 per cent protection. A newer alternative system makes demands of such a nature as to put it virtually out of court for probably a long time yet. Certainly, the Graviner system involves problems; installation in bag-tanks is one—but none of these problems, so far as can be seen at present, is of a kind which appears insoluble. We would go so far as to guess that, if a full-blooded attack were made on the problems known to exist, the system could be cleared for general installation within six months.

Following Graviners display of the system at the S.B.A.C. Show in 1949, a demonstration-cum-trial was arranged with de Havillands at Hatfield, and the fact that fuel tanks fitted with suppression equipment would not explode when incendiary and ordinary bullets were fired through them was made clearly apparent. In the face of lack of Ministry approval, and the absence of installation and performance data, de Havillands were unable to carry the matter farther.

Another series of tests of an essentially similar character was undertaken at the R.A.E., and again the results were convincing. A film was made of these tests; and no one, we feel, after seeing it, could fail to be aware that here was something of tremendous importance. The explosion of a fuel-tank resulting from the passage of an incendiary bullet is frightening—an appalling sight. And yet, by the inclusion of a comparatively simple suppression device, all that horror can be obviated.

American Contrast

By contrast with the dilatory attitude evidenced in this country, American aircraft manufacturers and research establishments became quite excited about the suppression system. As a result, demands were made on Graviners to supply components and data for examination and trial in the United States. (Simmonds Aerocessories, Inc., are the U.S. licensees of Graviner equipment). At the present time, Wright Field are working on the system; the C.A.A. establishment at Indianapolis is keenly investigating it; and Republic have actually installed and tested the system in an F-84 wing. Grumman are hot on the scent and, not by any means least, Mr. McLennan, one of the two inventors of the system, has recently taken up new employment with Lockheeds. It appears almost certain that the first aircraft to fly with explosion suppression as an integral system will be American—and good luck to them for their foresight.

Having stated the situation as we understand it, it remains to appraise the actual system of explosion suppression as it now exists. In Fig. 1 is plotted a typical curve of pressure increase against time, experienced during an explosion of a fuel/air mixture in a confined space. After ten milliseconds, the pressure is still a moderate 1 to 1½ lb/sq in; at 5 msec the pressure has risen to 5 lb/sq in; and in 42 msec, the pressure has risen to 90 lb/sq in. The maximum explosive pressure is approximately 110 lb/sq in. By contrast, Fig. 2 shows the pressure history of a suppressed explosion. Up to 10 msec, the explosion is identical with that of the free explosion plotted in Fig. 1. During this very brief period of time, the

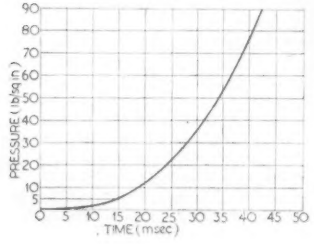


Fig. 1. Typical curves of explosive pressure-rise in a confined space of fuel/air mixture.

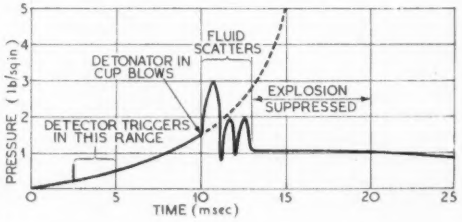


Fig. 2. Typical curve of pressure development in a suppressed explosion of fuel/air in a confined space.

suppression equipment functions, and the pressure rise is broken; in fact, it never exceeds a value of more than 3 lb/sq in. The ripples of pressure trace the action of the suppression equipment. Since aircraft fuel tanks can be relied upon to withstand a pressure of, perhaps, only 10 lb/sq in, the advantages of the suppression system can be appreciated.

The principal elements of the system consist of a detector and a distributor cup installed in the tank and connected to battery supply. A diagram of a tank installation is shown in Fig. 3. Upon an explosion originating from some source of ignition (A) pressure waves (B), travelling at the speed of sound, trigger the detector so that the electrical circuit is closed. The detonator placed in the cup is, consequently, blown, thereby shattering the frangible hemisphere of the cup, and scattering the suppressant fluid thoughout the tank. The scatter-pattern of the fluid (C) has been photographed with high-speed cameras, and the speed of scatter was measured in this way. Initial speeds are of the order of 300ft/sec. The flame-front (D) travels out from the source of ignition at a maximum of 5ft/sec. Data reviewed to date indicate that 5ft/sec represents a value of flame-front speed somewhat beyond the highest encountered. With the flame-front developing as slowly as it does, there is ample time in a properly designed installation for the detector to pick up the pressure-increase and trigger the detonator, and for the resultant scattering of the fluid throughout the tank to quench the flame-front.

In engineering an installation, careful attention must be paid to the details of timing. Since the pressure-increase is transmitted at the speed of sound, the time-lag involved in triggering the detector is negligible. A lag of about 2 msec is involved in detector operation. The time required for the transmission of the electrical signal to the detonator can be ignored. The detonator blows within a time of 2 msec. The entire sequence of events takes place within a time-lag of 4 to 5 msec. For this reason, it is necessary to place distributor cups within the tank so that all portions of the tank space receive suppressant fluid before the flame-front expands sufficiently to increase pressure within the tank above the allowable limit—usually 3 lb/sq in.

As a general rule, it is preferable to design an installation so that any one cup can be relied upon to suppress within a radius of only 18in to 24in. Within this radius the scatter speed is approximately 300ft/sec. The actual range of the scatter mist is considerably beyond 24in, but the time for scatter must be considered. For complete protection against explosions, calculations and tests so far indicate that 8 c.c. of suppressing fluid per U.S. gallon of space is required. It may be possible substantially to decrease the quantity of suppressing fluid if less than complete, but a still practical, protection can be accepted.

Various fluids can be used: carbon tetrachloride is a common extinguishant and acts by cooling and chemical inerting. This fluid may also be considered to act to unbalance the fuel/air ratio. Water, which has been used successfully, acts mainly by cooling. Other standard extinguishants can be used. Petrol has been used as an extinguishant in a few tests, and it successfully suppresses the explosion by creating a too-rich fuel/air ratio.

Some information has been presented which would indicate that the flame-front following the pressure-wave can, under specific conditions, travel at the speed of sound. Obviously, in such explosions the suppression system is not effective. Flame-fronts of this speed have not been met in the present experimental work; information has been reviewed which indicates that these speeds are met only in explosions in long tubes at initial pressures substantially above atmospheric.

The principal elements of the detector used in the majority of the tests in England and America are shown in Fig. 4. Details, and even some secondary features, are not included. An air space is sealed off between two opposing diaphragms. This confined space is, however, open to the surrounding atmosphere through orifices in both diaphragms. If pressure increases at a slow rate, equalization occurs through the orifices and the diaphragms do not move. If it increases at an explosive rate, the orifices are not able to equalize the pressure quickly enough, and the diaphragms deflect toward each other, permitting the electrical contacts to close the circuit. Once steady-state conditions are again reached, the diaphragms move apart and are ready for re-actuation. The orifice area in relation to the internal volume establishes the rate of pressure rise at which the detector will trigger. The spring force of the diaphragms establishes the pressure at which triggering will occur.

This type of detector has been found to be reliable. Provision is being made for overcoming vibration of the balanced spring diaphragms and to prevent the entry of fuel into the various cavities. Simple magnets are used to hold the diaphragms against vibration, the mass of the diaphragms being small enough to permit the use of quite small magnets. The end openings of the detector housing are covered with a sealing film so that fuel cannot upset the calibration of the orifices or disturb the diaphragms by splashing.

Reaction Pressure Rates

An explosive rate of pressure-rise is of a much higher order than pressure-rises experienced in any tactical manœuvre. The shock wave of a non-incendiary bullet passing through the tank has not triggered the detector. Tanks have been dropped at least 6ft to the ground and detectors have not triggered. Incendiary tests have been performed on detectors with and without a sealing end-film, and in both cases operation is satisfactory. The detectors are set to trigger at a pressure level of from 0.25 to 0.5 lb/sq in. Rate of pressure-rise setting is best established for the specific application and the optimum point is somewhere between 50 and 100 lb/sq in/min.

In any tank of a size met in aircraft, a single detector should suffice unless the baffling arrangement or cavities either stop or dampen the pressure signal. A number of types and sizes of distributor cups have been made, and the most satisfactory one is the phenolic-impregnated fabric type shown in Fig. 5. The cup has a relatively stiff backing plate which includes a housing for the detonator. The wall of the housing is reduced locally at the working end of the detonator. The frangible, phenolic-impregnated fabric hemisphere is securely attached to the backing plate, forming a sealed cavity to contain the suppressant fluid. When the detonator is blown, the hemisphere breaks into relatively large pieces and the fluid is scattered throughout the tank as a fine mist. This type of cup has been selected for future work because the relatively tough fabric withstands the shattering of a second cup

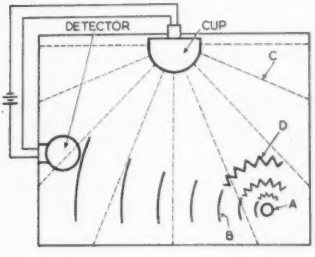


Fig. 3. Diagram of pressure-wave and flame-front travel during an explosion, and the resulting actuation of the suppression equipment.

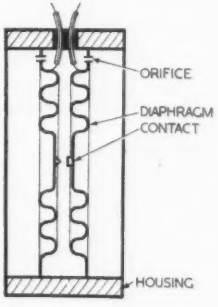
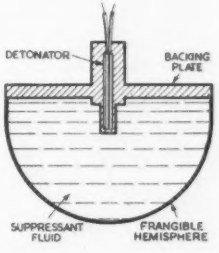


Fig. 4. Basic elements of explosion suppression detector unit.

Fig. 5. Basic elements of explosion suppression distributor cup.



EXPLOSION SUPPRESSION . . .

placed immediately next to it, and because the fragments of the cup are sufficiently large so that they cannot clog the fuel filters. The ability to survive the impact of the flying particles of a first cup is obviously useful in a multiple-shot system.

Speed of spray-front travel can be varied by use of detonators of different strengths. The detonators are a special high-speed type; the action is explosive and not flaring. It is, therefore, desirable to use the least powerful type for the application. Fragments of the detonator and of the fabric hemisphere have in no case damaged the wall of any standard aircraft tank though pitting may occur on metal tanks. The suppressant is not readily absorbed in the fuel and none of the products of the process are sufficiently concentrated to disturb engine operation if the normal filtering provisions are made.

The cup, incidentally, is an extremely compact storage container for extinguishing fluids, the large majority of total weight being the extinguishant. It does not require pressurization. It appears that the flying fragments of the cup do not seriously injure a man even at close range. The cup's possibilities as a fire extinguisher are being investigated.

Interconnection Problems

Interconnected tanks appeared to present additional problems, and, therefore, experiments were carried out on such units. With all the interconnected tanks filled with an explosive mixture, an explosion in one, if not suppressed, carries through to adjacent tanks. In protected installations, if the source of ignition is remote from the interconnection, suppression of the explosion occurs in the tank, and spread of the explosion to other tanks is prevented. If the ignition occurs near an interconnection the explosion travels through to the adjacent tank and the suppression systems in both tanks operate.

Complete data are not yet available relating to the time period during which the suppressing fluid provides protection once it has been released. Only flight experience, most probably, can provide the answer. Certainly, the suppressant provides protection during the time period of a single burst of incendiaries. If the bullet punctures are small enough, so that the tanks are sealed in short order, the suppressant will be retained for a considerable time. If the puncture is so placed that it does not favour the entrance of an airstream, the suppressant will be retained longer. If, on the other hand, the punctures are large, or a strong airstream can pass through the damaged tank, it is most probable that future explosions cannot occur because of the lack of a fuel/air mixture within explosive limits, or because the explosion is rapidly vented so that destructive pressures cannot be developed. The data so far reviewed indicate that in a single burst of incendiary, several rounds can pass through a single tank, though the incidence is infrequent. However, multiple bursts, each separated by substantial periods of time, are extremely rare during a single attack.

The advantages of the explosion suppression system can conservatively be summed up as follows :—

(1) The components are simple, of low weight, use no strategically scarce materials, and could eventually be standardized.
(2) The components are self-contained, require the simplest attention over a service period, and do not rely upon a constant supply of materials which require replenishment.
(3) The system provides protection at all times, even for parked aircraft and at the inception of flight. It is not necessary to anticipate attack to prepare the system for operation. The system is fully automatic in all respects.
(4) The extinguishant is at the immediate location of the explosion and is not dependent upon ducting or other means for conveying it to the explosion locality. The equipment is designed for installation within the fuel tanks so that additional space, always at a premium, is unnecessary.
(5) Should one tank of an interconnected series be sufficiently ruptured to permit vapours and gases to escape rapidly, protection is still afforded to the other tanks of the interconnected series.
(6) The system is independent of tank-system design and can be tailored to any configuration now known.

That the suppressant cups are also outstandingly efficient fire extinguishers is a particularly important fact which deserves considerable emphasis As a means of delivering a relatively large amount of extinguishant in ultra-short order —an imperative necessity with gas-turbines, where high mass-flows obtain—the cups are ideal. In such an instance they would, of course, be triggered by the pilot following on fire warning, or would be detonated automatically in a crash. Furthermore, the use of suppressant cups for fire protection, as well as being more efficient, would have the advantage of standardization of parts in an aircraft installation.

There may be good reasons why the Ministry department responsible have been so slothful about explosion suppression. But that the reason, if it exists, has anything to do with the technical performance of the system we cannot reconcile with the widespread and intense interest shown for it in America. If Farnborough have discovered that the system is for some reason impracticable, the Americans ought to be advised. After all it *is* a British system, and even if we choose to spurn it ourselves, we still have the ethical responsibility of having brought it to light.

U.S.A.F. ORDERS MORE SABRES

THE United States Air Force recently placed orders for the North American F-86F and the F-86H. Production of the Mk F at Columbus, Ohio, is scheduled for early in 1952, with the H to follow a few months later at Los Angeles. Both new types will be equipped with the General Electric J-47 turbojet.

The F-86H will be slightly larger than the F-86E. It will have improved suspension and release mechanism for droppable fuel tanks, in conjunction with bombs and rockets; other armament will include 0.50 calibre machine-guns. The power-boosted tail control surfaces will be larger than on the F-86E and the tailplane without dihedral, while the landing gear will be heavier.

Designed for high performance as a fighter and ground support aircraft, the F-86H is the fifth of the Sabre production series and the F-86F the fourth.

A GLIMPSE OF THE RUSSIANS

A TYPICAL Russian airfield in Germany is described by a correspondent. It is that of Grossenhain, 60 km north-west of Dresden, on the highway from Berlin. This was one of the first German bases taken over by the Russian Air Force in 1945, and most of the original installations are intact. During 1948 the runway, which runs east-west, was lengthened to 2,500 m; then came a radar installation and two radio stations, one of which is mobile and is at present located on the opposite side of the highway from the airfield. Soviet personnel number about 3,000 and there are three companies of the Volkspolizei for guard duties, the sentries being stationed at 20 m intervals. At present there are 120 Mig-15s on the station and, as usual, some Po-2s and Yak-14s for training and communications. Operational training includes mock combats, ground attack and formation work, the numbers of aircraft engaged simultaneously usually numbering seven or nine.

R.A.F. BENEVOLENT FUND HELPS 17,772

DURING the first nine months of this year, 17,772 cases of serving or ex-Service R.A.F. and W.R.A.F. personnel, or their dependants, have been helped by the R.A.F. Benevolent Fund to the extent of £452,513.

Making this announcement last week, A.V-M. Sir John Cordingly, controller of the Fund, said that expenditure showed an increase on the figure for the corresponding period of last year. This was to be expected, in view of the rise in the cost of living; what was more serious, however, was the fact that income during the first nine months of this year fell far short of expenditure. Moreover, expenditure was certain to increase, steadily but remorselessly, as veterans of the war years grew older and came to need assistance, perhaps for the first time.

In England, 14,027 cases were helped at a cost of £392,684; Scottish cases totalled 1,307 and shared £17,426; £20,408 was spent in Wales and aided 877 cases. In Northern Ireland, 295 cases received a total of £3,146. and in Eire 852 cases received £7,537. There were 414 overseas cases who received £11,309.

FROM ALL QUARTERS

Canberra for Woomera

SPECULATION is aroused by the news that an English Electric Canberra jet bomber will fly out to Australia next month for secret tests over the Woomera range. The machine will remain the property of the Ministry of Supply and will be equipped with a variety of special radio and radar equipment. Presumably it will be used for tests of guided missiles and/or controlled bombs.

This will be the third Canberra to fly to Australia, two examples having already been supplied to the R.A.A.F. for tests and studies prior to production of the type in Australia.

An Armstrong Siddeley Appointment

FROM the Hawker Siddeley Group comes an announcement that Mr. W. T. W. Ballantyne, A.M.I.Ae.E., is to join Armstrong Siddeley Motors, where he will act in liaison with the increasingly large number of aircraft constructors using the firm's engines. Latterly regional representative of the S.B.A.C. in Latin America, Mr. Ballantyne has had a long and varied experience covering the technical, flying and business aspects of the aircraft industry and dating from the time when, in 1915, he joined the Aircraft Manufacturing Co. at Hendon. He went to their successors, the de Havilland Aircraft Co., in 1922, and in 1929 became that company's special representative in South America. He served for a short period in the R.A.F. at the end of the 1914-18 war, and was for ten years a member of the R.A.F.O.; in the 1939-45 war he was initially with the British Air Commission in the United States and subsequently British Air Attaché in Venezuela, in which post he held the rank of squadron leader.

Mr. Ballantyne.

Hilary St. George Saunders

REMEMBERED as the writer of official war publications of exceptional literary merit, Hilary St. George Saunders died in the Bahamas last week at the age of 53. His works included *Battle of Britain*, *Bomber Command*, *Coastal Command*, *Per Ardua*, and *By Air to Battle*. All who have read these little books will recall how brilliantly Saunders combined technical accuracy with popular appeal. The publications sold literally in millions—all over the world—but their author drew pay only as temporary Civil Servant. At the time of his death he was engaged, with D. G. Richards, on a history, *The Royal Air Force, 1939 to 1945*.

From 1946 until 1950 he was librarian of the House of Commons. Much of his spare time was spent in the writing of novels, in collaboration with the late John Palmer and under the pen-names of Francis Beeding and David Pilgrim.

Mr. Habnit, who is giving up ownership of the Dutch aviation journal "Vliegwereld" and will in future act as P.R.O. to the Netherlands Air Force (see news item below).

"Vliegwereld" No Longer

SHORTLY going to the Netherlands Air Force as public relations officer is Mr. F. F. Habnit, well known to many people in this country, as well as abroad, as editor of the Dutch aviation journal *Vliegwereld*.

While wishing Mr. Habnit success in his new post, we are sorry to hear from him that *Vliegwereld*, which he launched in 1935, now ceases its independent existence. "Especially since the loss of Indonesia," says Mr. Habnit, "Holland has become too small to support an aviation weekly." The journal is beng merged with *Avia*, the fortnightly official organ of the Royal Dutch Aero Club, but its name will be perpetuated in the new title *Avia-Vliegwereld*.

Another Nuclear-power Contract

A RECENT statement by the Atomic Energy Commission and the U.S.A.F. (we quoted it last week, in introducing an article on atomic-powered aircraft) said that "complex problems remained to be resolved before such a power plant could be made, installed and flown," and added that a contract had been awarded to General Electric for the ultimate manufacture of a nuclear-reactor engine.

Now comes news—released in Washington shortly before Christmas—that a second contract has been put out, this time to the Pratt and Whitney division of United Aircraft Corporation. No details were given, other than that the new order concerns a type of unit differing from that on which General Electric are working.

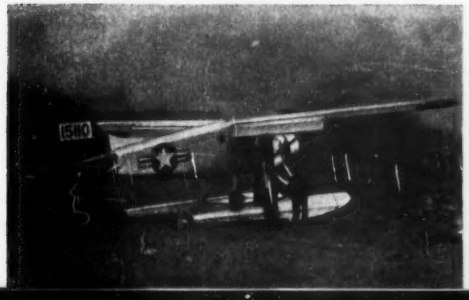
Benefits for Bristol Employees

AT a meeting of employees held on December 18th, the directors of the Bristol Aeroplane Co., Ltd., announced a new retirement-benefit and life-assurance scheme which will come into operation on January 1st. It is entirely financed by the company and involves no contributions by the employees.

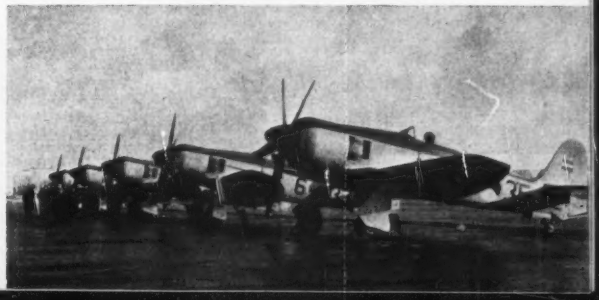
The retirement benefit provides for a payment, at the normal retirement age of 65 (women 60) of a lump sum, representing £5 for every year served since the age of 25 (ex-apprentices 21). Maximum benefits are therefore £220 (ex-apprentices), £200 (other men) and £175 (women). Employees do not enter the scheme until they have served for three years and attained the age of 25 (women 30); benefits are then retrospective.

In the life-assurance scheme the sum for which workers are assured is £200 (women £150), plus £5 for each year of retirement-benefit service completed up to the date of decease.

AMPHIBIOUS ATTEMPT by a U.S.A.F. Beaver pilot who overshot the small Alaskan lake on which he was attempting to alight; the only damage was a bent float strut and two sprung rivets. The U.S.A.F. has now taken delivery of "a substantial number" of Beavers ordered from the D.H. Canadian company.



FIVE MORE Fokker-built Hawker Sea Fury F.B.11s for the Royal Dutch Naval Air Force were recently received by Capt. (T) D. van Leeuwen, R.N.N. (representing the Minister of the Navy) from the Fokker managing directors, Ir. P. J. C. Vos, O.B.E., and E. van der Woude. F/L. H. Moekardanoe made the acceptance-tests.



HERE AND THERE

Packets for Canada

IT is reported from Ottawa that Canada has ordered 48 Fairchild Packet military transports at a total cost of over 38½ million dollars. Delivery is not expected "for a considerable time."

Leonides-Powered Fiat

TWO radial-engined versions of the G.49 basic trainer are announced by the Fiat company. One (G.49-1) is to have an Alvis Leonides 502, and the second (G.49-2) will have a Pratt and Whitney Wasp Junior.

Selected

AMONG "pictures of the year" from various journals, reproduced in the Christmas issue of W. H. Smith and Son's *Trade Circular*, is one of John Yoxall's remarkable air-to-air pictures of No. 66 Squadron's Meteor 8s looping in formation.

Objections Overruled

FOLLOWING a public inquiry, at which a proposal to establish an air-to-air firing range off the coast between Scarborough and Flamborough Head was opposed by nine local authorities, the Ministry of Housing and Local Government has announced that the Air Ministry is to be allowed to proceed with the plans. The range will cover an area of sea measuring 18 miles by 12 miles.

OVER THE TOP: Surely one of the most dramatic aerial photographs ever secured is this latest shot by Russell Adams, showing the rocket-armed Gloster P.V. Meteor (pilot, Zurakowski) over the vertical in a loop. It was on this prototype that Zura introduced his "cartwheel" at Farnborough.

American Gas-turbine Helicopter

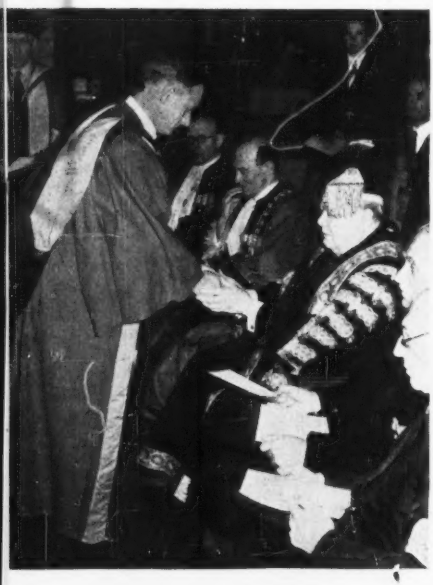
THE U.S. Navy is reported to have flown a helicopter powered by a 175 h.p. Boeing T-50 gas turbine. This little unit weighs 205 lb.

Carrier-borne Troop-carrier

TO the newest version of the carrier-borne Douglas Skyraider (AD-5) the description "multi-purpose" can be justly applied. It can be quickly converted for bombing, torpedo-dropping, rocket-firing, photography, target-towing, ambulance work, early-warning radar "picketing"—and even transport, having accommodation, it is said, for six or seven passengers. The maximum war load (bombs, rockets or torpedoes) is 8,000 lb.

Escapee

LANDING at Castel Benito to refuel while on a charter flight from Delhi to Amsterdam, Capt. William Key, a B.O.A.C. pilot, found that a leopard—part of his cargo destined for the Amsterdam Zoo—had escaped from its cage. After an unsuccessful attempt to shoot the animal (the shots being aimed, it is reported, *through* the fuselage), it was given poisoned food.



THE PRIME MINISTER, wearing his robes as Chancellor of Bristol University, confers the honorary degree of Doctor of Science (Engineering) on Mr. A. E. Russell, who developed the Brabazon design. Mr. Churchill also laid the foundation-stone of the University's new engineering school.

WEST FOR CHRISTMAS: Sir Richard Fairey, with Lady Fairey and their daughter Jane, aboard the "Queen Mary" on their way to New York last week.

Instrumentation by SMITHS

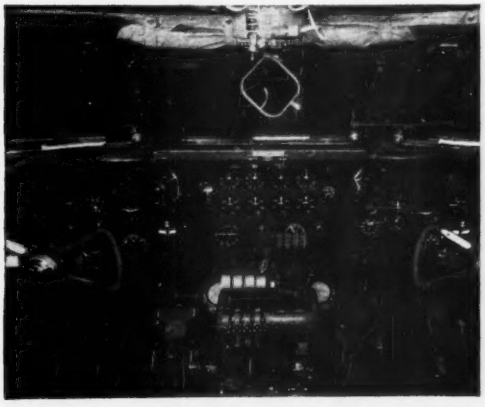
STOP PRESS

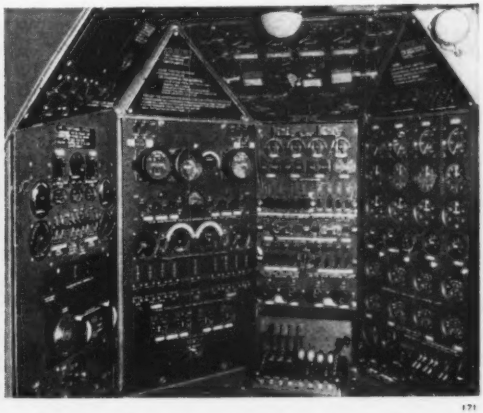
Fitted of course with the SMITHS-WAYMOUTH Electrostatic Fuel Contents Gauge

No 2 **Handley-Page Hermes IV**—The Aviation Service of Smiths Aircraft Instruments Ltd, co-operate in the design of instrument panels, and liaison with aircraft designers from the earliest stage is a feature of SMITHS organisation. From the latest range of SMITHS products were chosen the majority of the instruments for the Hermes IV and the photographs shown below illustrate the wide variety of instruments used on the pilot's and flight engineer's panels.

SPECIAL FEATURES INCLUDE

★ *Smiths Electric Auto-Pilot* (S.E.P.1) and the ★ *New Torque Pressure Indicator*





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The Aviation Division of S. Smith & Sons (England) Ltd

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C

Impressions of modern aircraft

THE VICKERS 'SWIFT'

Equipped with the Lockheed 'Servodyne'* system of power assistance to flying controls.

ALL-BRITISH Lockheed

REGD. TRADE MARK

* Regd. Trade Mark.

AUTOMOTIVE PRODUCTS COMPANY LTD., LEAMINGTON SPA, ENGLAND.

HERE AND THERE . . .

Rubber Supplies

SOME remarkable new developments in synthetic rubber are now in the experimental stage, said Sir Clive Bailleu (Dunlop chairman) at the recent annual dinner of the Institution of the Rubber Industry. Nevertheless, he added, it was necessary to regard as of the greatest importance the continuance of supplies of natural rubber from Malaya and Indonesia, which constituted the lifeline of the industry today; the prospect could be viewed with hope, but not with complacency.

Science Museum Lectures

AMONG forthcoming lectures (admission free) at the Science Museum, South Kensington, will be talks on *Historical Aircraft Up to* 1903 (in the lecture theatre, 3.15 p.m., Friday, January 4th), *The Aircraft and Aero Engine Collection* (Western Galleries, 11.15 a.m., Friday, January 18th) and *History of Gliding, and Meteorology Concerned with the Subject* (lecture theatre, 3.15 p.m., Tuesday, January 22nd). In each case Mr. C. Tilghman Richards, M.I.Mech.E., F.R.Ae.S., is the lecturer.

G/C. CHRISTOPHER CLARKSON, whose impending departure from the post of British Civil Air Attaché in Washington was announced by the M.C.A. some months ago, is still there—and will be until January 31st, when he will be succeeded by Mr. R. S. S. Dickinson. "Chris's" future plans are uncertain at the moment.

Lecture to the Lords

AT the invitation of the Independent Unionist Peers, Mr. William Courtenay, O.B.E., M.M., recently gave a talk at the House of Lords on *The Air War in Korea*. Discussing the influence of the success of the air war on the trend of the truce talks, he spoke of the danger of permitting the Chinese Communists to prepare airfields or repair airstrips during a lull or armistice.

Aircraft Standards

THE following are among new British Standards now available: B.S. SP. 33-39: 1951 — *Turnbarrels, Tension Rods and Swaged Cable-end Connections for Aircraft;* B.S. SP. 41-46: 1951—*Tab Washers for Aircraft;* B.S. PL1: 1951—*Synthetic Resin Phenolic Mouldings for Aircraft;* B.S. 1798: 1951—*Symbols, Terms and Definitions for Gas Quantities in Reciprocating Internal Combustion Engines.* Copies are available (at prices of 2s. 6d., 1s., 1s. and 1s. 6d., respectively) from the British Standards Institution, Sales Department, 24 Victoria Street, London, S.W.1.

THE WIND IN THE BILLOWS: Rotor downwash—made strikingly apparent in this picture of a U.S. Navy S.51—can either hinder or assist helicopter rescue-operations, according to circumstances. A few weeks ago an American pilot utilized the effect to "blow ashore" a rubber dinghy in which two children were adrift.

IN BRIEF

TWENTY lectures given at the Aero Research, Ltd., Summer School this year have been collected in book form under the title *Structural Adhesives—The Theory and Practice of Gluing with Synthetic Resins.* The publishers are Lange, Maxwell and Springer, Ltd., 41-45 Neal Street, London W.C.2, and the price is 21s. (by post, 1s. 6d. extra).

* * *

Cdr. E. H. G. Stokes, R.N., well known in the industry as public relations officer at Air Service Training, Ltd., has recently left that post; he informs us that, for the time being, his duties are being taken over by Mr. George Kertesz, technical assistant to the director (training).

* * *

Capt. H. S. Broad, M.B.E., A.F.C., who recently relinquished his appointment with Dowty Equipment, Ltd., has joined the Board of Wynstruments, Ltd., Staverton Aerodrome, Gloucester. Capt. Broad is also a director of Aircraft and Automobile Services, Ltd., and of Kenton Equipment, Ltd., who are world distributors of the B.O.A.C. weighing machine.

* * *

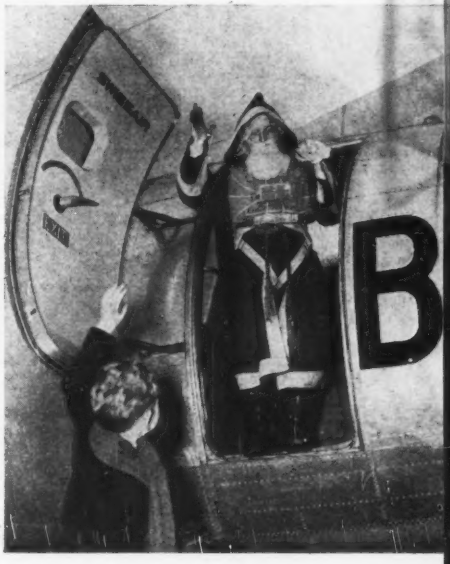
Mr. D. J. Hopley has been appointed managing director of Oldham and Son (India), Ltd., recently established associate company of Oldham and Son, Ltd., the storage battery makers of Denton, Manchester. He succeeds Mr. Edgar Oldham, who was seconded to the Indian company to set up its initial organization, and who is now returning to England to continue his work as chief technical officer in the overseas control division of the parent company.

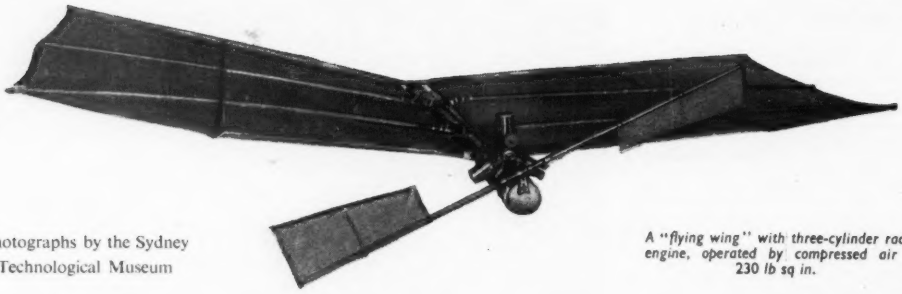
PRESENT AND CORRECT: Seen leaving for Zurich is Arthur Harrison, who was selected from over 200 applicants for the job of making a Santa Claus parachute descent over a hotel near St. Moritz—with a landing on an ice-covered lake, on which a reindeer sleigh waited. Harrison, who has made 62 jumps, is engaged on duties in connection with airborne warfare research for the British Army.

Mr. Hopley served in the R.A.F. from 1935 to 1945, initially training as a radio operator and later serving as an instructor to the Indian Air Force.

* * *

Some remarkable high-speed camera sequences are included in a new colour-film, *The Argonarc Welding Process*, recently released by the British Oxygen Co., Ltd., Bridgewater House, Cleveland Row, London, S.W.1. The second reel, devoted to the welding of light alloys, includes illustrations of the firm's new "Argonaut" technique for this purpose.





Photographs by the Sydney Technological Museum

A "flying wing" with three-cylinder radial engine, operated by compressed air at 230 lb sq in.

AUSTRALIA HONOURS a PIONEER

Sydney University Chair in Memory of Lawrence Hargrave

By V. STRATTON

IN designating its chair of aeronautics the "Lawrence Hargrave Chair of Aeronautical Engineering," the Senate of the University of Sydney, Australia, has paid a graceful tribute to an outstanding Australian whose selflessness and creative and inventive genius won for him the well-merited epithet "The Father of Aviation."

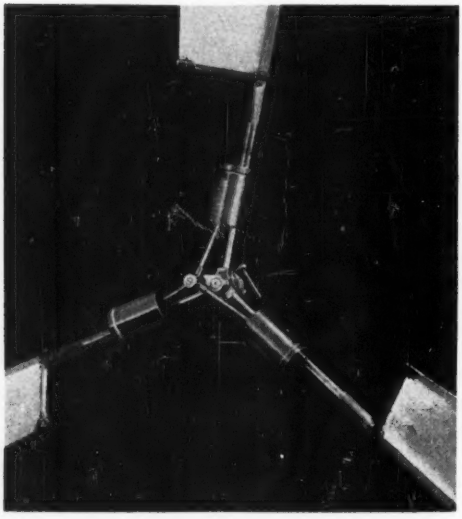
Lawrence Hargrave, who was born in England in 1850, and died in Australia in 1915, has always been regarded as an Australian. He was only 16 when he arrived in that country and he lived the rest of his life and received all his technical training there.

The heavier-than-air flying machine was not invented by any single experimenter; it gradually evolved as the result of the efforts of many pioneers in the field. Hargrave did as much to bring about the accomplishment of dynamic flight as did any other single individual.

When he arrived in Australia in 1866 he was apprenticed to an engineering firm and later received a post as assistant at the Sydney Observatory. While at the observatory he became fired with the ambition to solve the problem of human flight, and eventually he made it his life's work. From 1884 to 1892 he experimented with monoplane models, and from 1892 until 1909—when his last paper on aeronautics appeared—he concentrated on box-kites and aerofoil surfaces. Between 1884 and 1909 he read 19 papers on aeronautics and kites before the Royal Society of New South Wales; and his papers and ideas were sent abroad freely, with no binding patent right. Discussing patent rights in 1890, Hargrave said, "Inventors will always invent; they cannot help it, and you cannot stop them; and a patentee is nothing but a legal robber." When he published his discoveries to the world, others often pirated them; but this was his wish, as he wanted every worker in the field of aviation to use his ideas freely and if possible to improve on them.

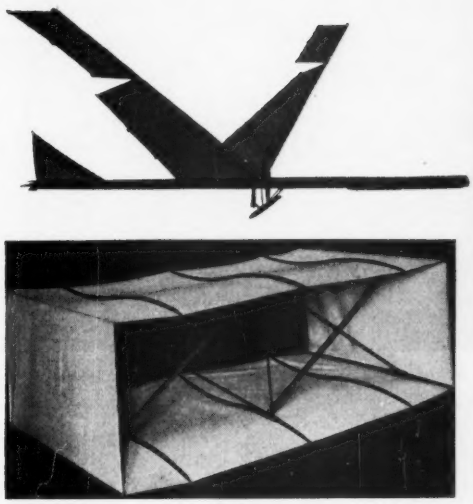
The Gnome rotary engine, patented in France, was based on an engine invented by Hargrave. The first aeroplane to fly publicly—the Santos Dumont, in France in 1906—was virtually an arrangement of the Hargrave-type kites. Hargrave lived long enough to receive the thanks and admiration of other great aviation pioneers, among whom were the Wright brothers.

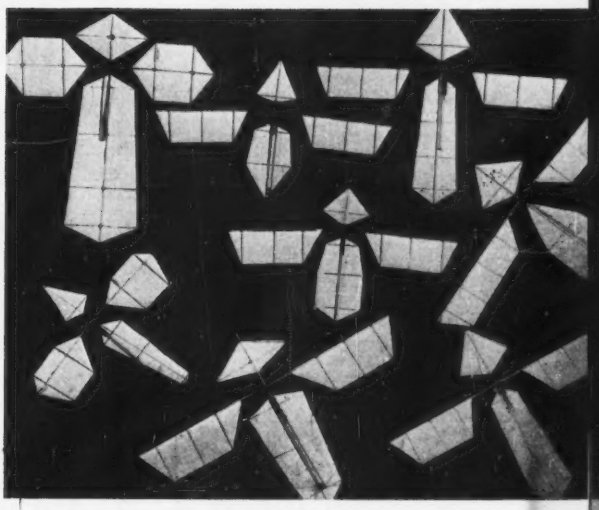
In 1910, German scientists proposed to Hargrave that, if his models were presented to that country, a special



(Left) One of Hargrave's most notable achievements was the design and construction, in 1889, of a successful rotary engine. This model was driven by compressed air; the three cylinders were mounted on the airscrew blade roots.

(Below) Close-up view of a single-cylinder compressed-air engine used on a flapping-wing model in 1890. The clock-wheel mounted on the side of the compressed air container was actuated by a ratchet from the wing, and served to record the number of flaps made.





(Right) A collection of Hargrave's earliest experimental models. These, and the others illustrated here, are replicas of the original models. (Top left) A rubber-powered ornithoper, or flapping-wing model, believed to have been made about 1885, *and indicating remarkable anticipation of orthodox monoplane design that was to follow many years later. (Bottom left) In* 1892 *Hargrave began to experiment with curved aerofoil surfaces, testing them on box-kites. This reversed-curve box-kite was made in* 1909.

building would be allotted to them. He accepted the offer and nearly all the models were sent to Munich; for he wanted his work to benefit mankind, and nationalism and frontiers had no place in his vision. In 1945 attempts were made to retrieve the working models of the flying machines from Munich; investigation proved, however, that these had been given to the museum and could not legally be taken away from it.

Exact replicas of the more important of these models have, however, been made from detailed plans published by Hargrave in the *Journal and Proceedings of the Royal Society of New South Wales* and are housed in the Museum of Applied Arts and Sciences at Ultimo, a suburb of Sydney. The models cover a wide range. One of his first, flown probably in 1885, was a flapping-wing machine with rubber bands in tension providing the motive-power. Hargrave's engineering genius allowed him gradually to evolve clockwork, petrol and steam power units for his models, and in 1889 he invented the rotary engine.

Curved Aerofoil Surfaces

Between 1884 and 1893 the inventor's time was devoted mainly to building and flying monoplane models with flat lifting surfaces, and driven by clockwork, rubber bands, compressed air or, lastly, steam. In 1892, he had performed a few experiments with curved surfaces, the behaviour of which opened to his imagination far-reaching possibilities. From then on he decided to concentrate his energies to the investigation of the principles of curved aerofoil surfaces, to discover how they might be adapted to enable man to rise from the ground in a machine heavier than the surrounding atmosphere.

In 1893, Hargrave began his kite experiments, which were destined to have an important influence on the solution of dynamic flight. A successful weight-lifting trial was accomplished in 1894, when four of his box-type kites attached to the one rope lifted a total weight of 208 lb.

It is on the box-kite that Hargrave's place in the history of aeronautical development is chiefly founded. His kites possessed greater stability, more lift and less drag than any apparatus discovered previously. He was the first to demonstrate that a relatively small lifting surface arranged as in his kites was sufficient to lift the weight of a man from the ground. Having accomplished this, he recognized clearly that the most important steps towards a man-carrying aeroplane were a light and efficient engine, and the fitting of adjustable tail-surfaces for control. The operating principle of the latter had already been enunciated by himself and others.

Towards the end of his life Hargrave took up the study of early Australian exploration.

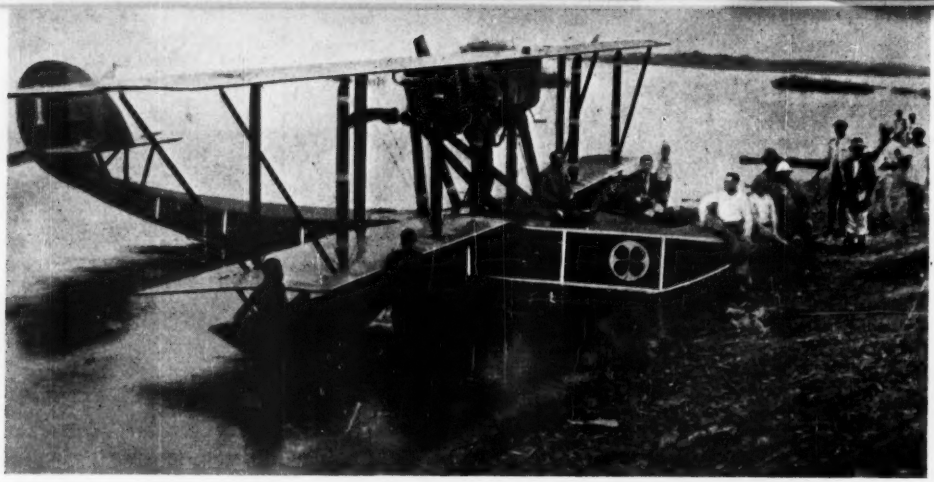
Designation of the chair of aeronautics at Sydney University as the Lawrence Hargrave Chair of Aeronautical Engineering is a worthy tribute to this great pioneer. Sydney University is the only university in Australia which has a chair of aeronautical engineering. The course extends over four years; during the first two years students study general engineering principles and during the latter half of the course concentrate on aeronautics. The chair, which was established ten years ago, is subsidised by the Australian Federal Government. Students wishing to graduate in aeronautical engineering, and who do not live in New South Wales, may take the first two years of the course in the universities in their own States and then transfer to Sydney for the final two years of their studies. There are at present 20 students taking the course and in the ten years since the foundation of the chair 150 students have graduated as aeronautical engineers, fully qualified to engage in all matters connected with the maintenance, construction and design of aircraft. Some of the graduates are now employed by leading aircraft manufacturing firms in the United Kingdom.

HANGAR LIGHTING

AN aircraft maintenance hangar, 220ft long, 170ft wide and 65ft high at Whenuapai airport, Auckland, New Zealand, has been lighted recently with 231 G.E.C. twin-lamp reflector fittings using Osram 5ft 80W fluorescent lamps. The installation was designed by the Wellington branch of the British General Electric Co., Ltd., in co-operation with the New Zealand Ministry of Works, and employs wooden battens to support the fittings, suspended from wire catenary cables strung at 21ft centres across the hangar, which is of reinforced concrete construction.

There are 11 rows of 21 fittings, each spaced evenly across the hangar. The two side rows, which are mounted in the angle between the walls and the roof, are fitted with half reflectors only. The mounting height is 28ft, and the scheme provides an illumination of 20 lumens/sq ft at the level of the aircraft engines.

Very favourable reports on the efficiency of the installation are said to have been received from mechanics of the National Airways Corporation working on aircraft in the hangar.



This Levy-Lepon three-seater flying-boat had the distinction of being the first aircraft in the world to operate on a colonial air service.

AFRICAN NOTEBOOK PART III — By THE EDITOR

SABENA'S CONGO AIRLINE

Development of the First Colonial Air Service: The Picture Today: Impressions on the Routes

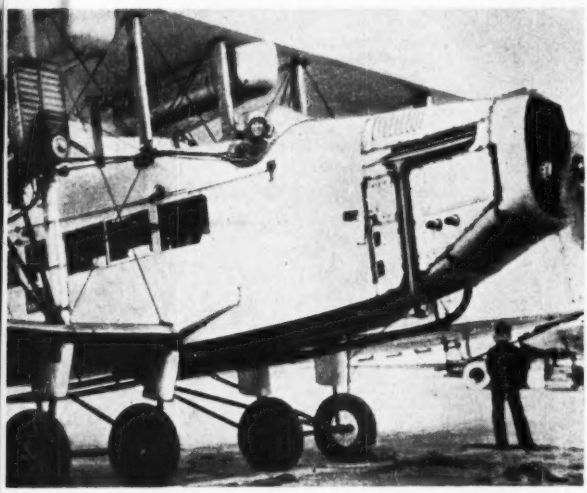
IT is twenty-one years since the first air service was inaugurated in the Belgian Congo, and a visitor to that vast country, in which the primitive is to be found side by side with the civilised in all its luxury, might be excused for supposing that the remarkable air services which have been operated almost continuously since July 1st, 1920, are indirectly responsible for the scarcity of other modern communications in the Congo. If the air can serve so well, why bother with other media?

Swamps, rivers and lakes abound in the Congo, and such roads as there are offer slow and difficult going, with many hazards. The fast-flowing Congo River is the main throughfare of the country, and Mississippi paddle-boats—two original and others copied in the Congo—ply up and down the navigable portions between Leopoldville and Stanleyville. Several other rivers, particularly the huge Kasai and Ubangi, are also navigable as are the higher sections of the Congo where it reverts to its native name of Lualaba River. The few stretches of railway chiefly serve to join towns on sections of the Congo River which cannot be navigated because of falls and rapids. Examples are the important links between Matardi (near the coast) and Leopoldville, between Stanleyville and Pothierville (round the Stanley Falls), and also from Kindu through other towns to Albertville.

This information is given to enable the reader to form a picture of Congo traffic. More particularly it shows that if an individual, mail, or, say, an essential spare part for a tractor (or, again, some perishable foodstuff) is to be carried across the country, then the air alone can make the journey possible in hours or perhaps a day or two. All other means of transport must take weeks. It is the air that will play the greatest part in the continued opening-up of the Belgian Congo and the exploitation of its immense natural resources although to date only the fringe of the air-freight potential has been touched.

To return to the earliest days, after a series of proving flights the first air service was established between Leopoldville and N'Gombe, 360 miles up the Congo River. It operated twice monthly and the aircraft were three-seater Levy-Lepon flying-boats with 300 h.p. Renault engines. Incidentally, this design was taken over by the Farman brothers at the end of the Great War. It was not long before the Service was extended farther up the Congo to Lisala (630 miles) and then to Stanleyville (1,070 miles).

The company behind these developments was known as SNETA (Syndicate Nationale pour l'Etude des Transports Aériens), and it had been formed on March 1st, 1919 at the direct instigation of King Albert I of the Belgians to study in the first place, aerial navigation and the operation of air services between Brussels and London. Some four months after the formation of SNETA—on June 26th, 1919—a second organisation was started in the Congo under the name CENAC, and this also owes much to the foresight of King Albert. CENAC stands for Comité d'Etudes pour la Navigation Aérienne Congo and was, in fact, concerned only with aerial photography and survey. For this reason SNETA was called in to look after the first services in the Congo in conjunction with CENAC, but because SNETA itself had been created to explore the operating and financial possibilities of airline operation its composition was more that of a holding company, and therefore LARA, standing



First airliner to operate on Belgian Congo services was the Handley Page Hamilton, or W.8F, ten-seater. It was also known as the Princess Marie-José type. The pilot here is Edmond Thieffry; the year is 1925; and the occasion the first flight between Brussels and Leopoldville.

The Royal Air Force have adopted . . .

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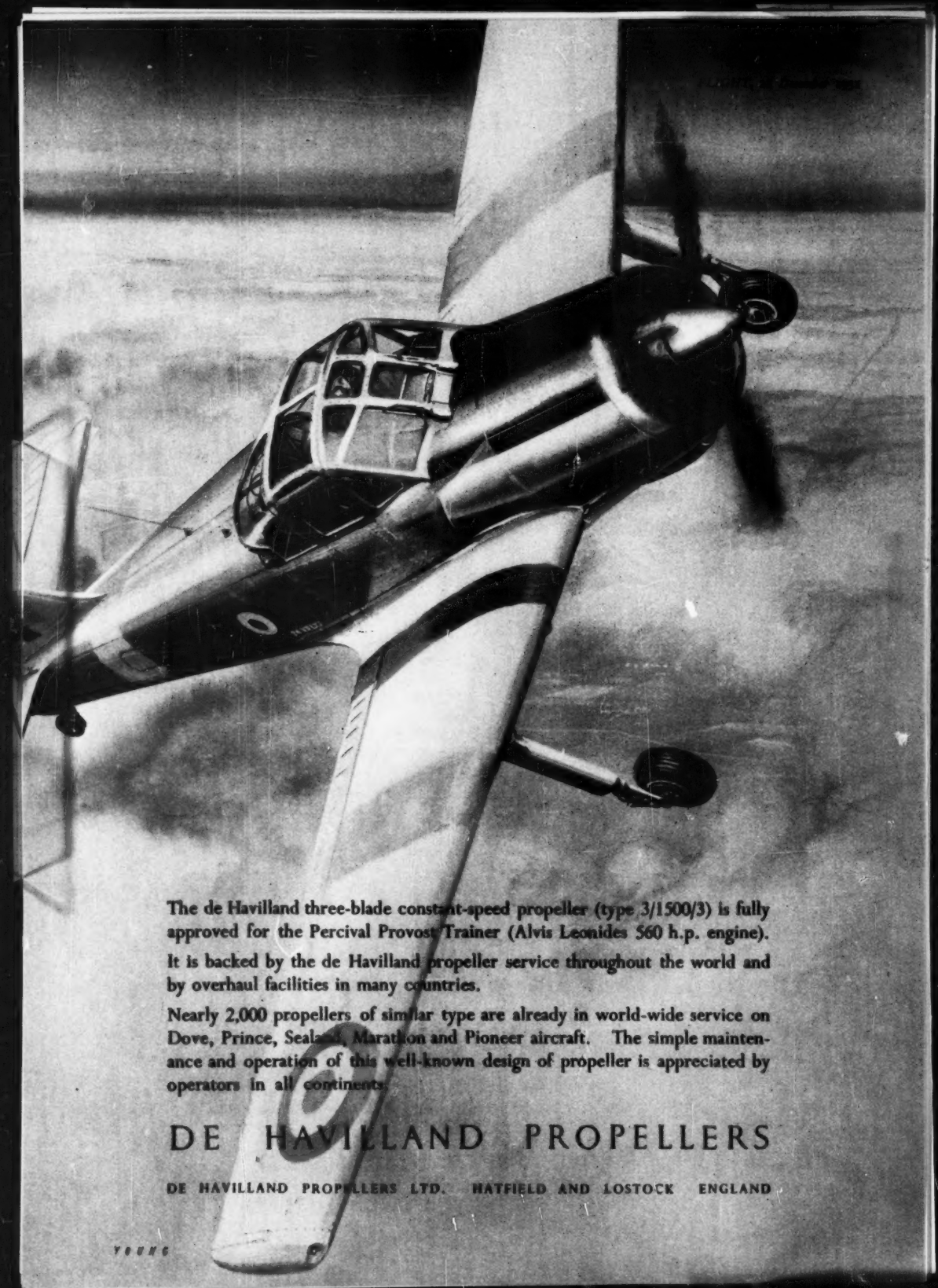

The de Havilland three-blade constant-speed propeller (type 3/1500/3) is fully approved for the Percival Provost Trainer (Alvis Leonides 560 h.p. engine).

It is backed by the de Havilland propeller service throughout the world and by overhaul facilities in many countries.

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YOUNG

The Belgian Congo, with river and rail thoroughfares accentuated. Above is the airline route-pattern for the area today, together with corrections outside the Congo.

SABENA'S CONGO AIRLINE . . .

for Ligne Aérienne du Roi Albert, was brought into being as the first Belgian Congo operator and, incidentally, the first colonial airline in the world.

There was a short lapse in colonial services from June 1922—when the two exploratory bodies, together with LARA, ceased air operations—until May 23rd, 1923, when SABENA (Société Anonyme Belge d'Exploitation de la Navigation Aérienne) was formed, to take over the active business of operating air services. Sabena was the outcome of an agreement between Belgium, the Belgian Congo, and SNETA, and the last-named organisation continued to act as a holding company until its original charter expired in 1949 after 30 years' work. During its short pioneer existence LARA, flying its twice-monthly three-seater flying-boat services, covered a total of nearly 78,000 miles, carrying 95 passengers and two tons of mail.

Sabena not only continued the follow-the-river policy of its forerunner, but set about laying down main airstrips, and others for emergency landings, to permit direct overland routes between the widely separated centres of activity in the Congo. Because several important towns were to be found along the Congo, the river route was also continued as it is today. Landplanes were substituted for the early flying-boats. It called for considerable courage to plan routes across the vast areas of swamp, forest and jungle, for there was little in the way of navigational equipment or aids and, once away from the big rivers, hundreds of miles of country might pass below without a single good pinpoint feature appearing. Again, weather is often far from ideal for flying.

During 1926 and 1927 Sabena started services between Luebo and Ngule (530 miles in the direction of Elizabethville), and in December 1927 Luebo and Tshikapa (100 miles south) were linked by an air service. Leopoldville was also linked with the seaport of Boma 220 miles away, and this completed the main trunk route between Elizabethville and the coast, a 2½-day flight taking in six main airfields. No fewer than 74 emergency strips had also to be prepared along this route. In 1926 useful work achieved as measured in tonne/km of transportation totalled 51,300, while in 1927 the figure had increased to 82,430.

During the next two years expansion continued from Luebo, which thus became something of an air centre. A service was opened to Lusambo (200 miles) and was then extended to Kabalo, a further 310 miles. By the end of its tenth year of operation Belgium's colonial airline had a 2,500-mile network of services.

The accompanying historical illustrations include photographs of one of two types of British landplane successfully operated by Sabena during this period of expansion, namely, the Handley Page three-engined W.8F, which carried ten passengers and of which type Sabena operated eight. It may be recalled that the W.8F, or Hamilton, had dissimilar engines—a Rolls-Royce Eagle IX in the nose and two Armstrong Siddeley Pumas outboard. The other aircraft type, of which Sabena had three, was the D.H.50 a single-engined machine with cabin for four passengers. In 1931 tri-motor Fokker F.VIIs were introduced, and these carried on until 1938 when they were replaced by Junkers Ju52s.

Except for the extension of the Leopoldville-Bandundu-Coquilhatville line to Stanleyville there were few other extensions during the difficult period of the early and middle 'thirties. The period was, however, marked by the inauguration of the first regular air service between Brussels and Leopoldville on February 23rd, 1935.

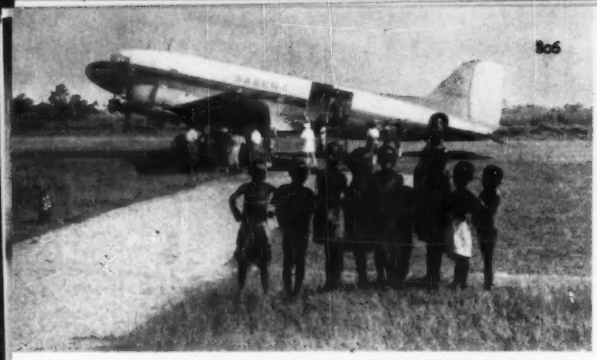
To bring this brief history up to date reference must be made to Sabena's war-time activities in the Congo area (for European services could not, of course, be operated). Because the Mediterranean services were closed to the Allies, Sabena was requested by the British Air Ministry to operate under-contract services between Elizabethville and Cairo *via* Nairobi and on a trans-African route between Accra, on the Gold Coast, and Wadi Halfa, *via* Lagos, Takoradi, Bangui, Stanleyville, Entebbe, Juba, Malakal and Khartoum, a distance of 3,100 miles. A Leopoldville-Lagos feeder service was also operated.

King Albert of the Belgians had much to do with the formation of the Belgian Airlines. He is seen talking to executives of SNETA in the year 1919. *The aircraft is a Rumpler C-4 with 260 h.p. Maybach engine.*

The Picture Today

The war did not prevent Sabena still further expanding its African domestic routes, and for the first time a South African service was organized. The 3,500-mile network of the beginning of the war had become almost 20,000 miles by 1945.

Today, by consolidation, the Congo services cover more miles than Sabena's European routes and rather more than three times the rail mileage in the territory. The total is 12,500 miles. The



There is always plenty of local colour to greet a Sabena service.

At Coquilhatville; refuelling an Air Force Oxford and a Dakota.

SABENA'S CONGO AIRLINE . . .

Kamembe airstrip, at the foot of Lake Kivu, which serves Costermansville.

Distinctly primitive airfield buildings at Usumbura, Lake Tanganyika.

The reception and refreshment hut at Irumu is quite picturesque.

Illustrated with "Flight" Photographs

Congo is linked with Johannesburg, Bulawayo, Nairobi and Loanda, as well as with Europe, by two different routes from Leopoldville (DC-6) and Stanleyville (DC-4). The former, which goes *via* Kano and Tripoli, places Leopoldville within 16 hours of Brussels, while the latter, *via* Khartoum, Cairo and Athens, with stops, takes two days to Brussels.

At present 31 separate places are served within the Belgian Congo and nine in surrounding countries. In fact, a dozen or more stages are operated which from the airline's point of view are uneconomical. These are assumed as a duty to the colony, and the ultimate aim is to achieve the ideal of a forty-airfield network which will bring every white centre within a few hours by road of the nearest airfield.

Already what may be called main-line services are operated to link up the trunk routes; DC-4s are used for the purpose. Several other fast services are operated out of Leopoldville each week, serving Stanleyville and Elizabethville. At present there are only four airfields in the international class; they are Elizabethville, Libenge, Leopoldville and Stanleyville, and of these only Leopoldville is able to receive aircraft of DC-6 and Constellation types, while the others take the DC-4 and, in the case of Elizabethville and Stanleyville, this only at a reduced all-up weight. The two last-named airfields are scheduled for the first main-runway extensions which are now planned and approved in the Congo, and another airfield, Usumbura, is high on the priority list for major improvements; it is one of some two dozen fields at present used only by DC-3s or smaller aircraft.

There is no doubt in the Congo that Sabena is entering upon a period of major traffic-increase, and that the two types of passenger service will develop in conjunction with the carriage of freight, including fruit and vegetables, and of mail, upon which there is no surtax.

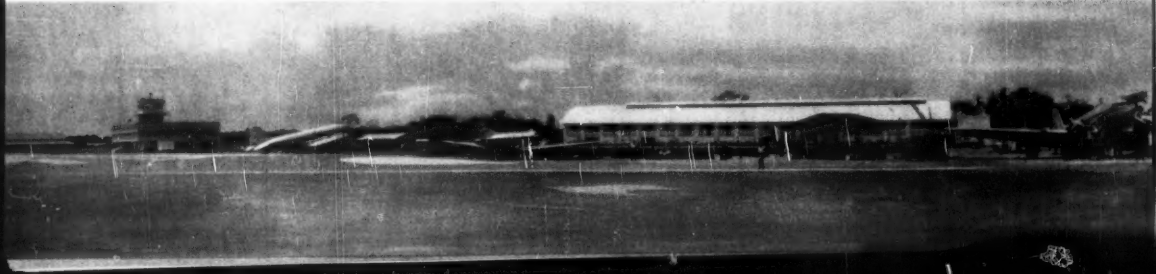
For the time being Sabena does not foresee the immediate equipment difficulties that other African airlines are facing, for provided the key airfields can be rendered suitable sufficient DC-4s can be made available to look after the increased main services; and DC-3s, though not ideal, are still well able to cope with the omnibus services.

The DC-3's two main shortcomings nowadays are inadequate capacity and a cruising speed which is too low for passenger work; and, moreover, on services where there can be no night flying, round trips returning to base cannot easily be completed in a day. In view of the amount of freight which is now offered for carriage by air, the possibilities of operating such aircraft as the Bristol 170 are again being considered in the Congo. Examples of this type have been flying for some time past in West Africa and are understood to have given very good service.

The DC-3s have to operate with load restrictions on certain of the small high-altitude strips, and there is also the problem of the single-engined performance after take-off. For this reason a careful study is being made of the possibility of installing a Turboméca Palas turbojet under the centre section for take-off and emergency use. In the single-engine case, use of a Palas would be equivalent to having an extra 150 h.p. from the good engine. If the investigations which are being carried out with S.N.C.A.S.O. in France mature, Sabena's Dakotas will be able to operate with additional security though not necessarily with increased load.

The alternative of employing Jato was investigated, but this seemed likely to cost approximately £50 per take-off and it also entailed certain transportation and storage difficulties.

The aircraft which eventually replaces the Dakotas should have



Relatively luxurious buildings grace the airstrip at Bumba on the Congo.

(Above) Refuelling completed, the Dakota prepares to leave Lisala. (Below) The process of refuelling entails the use of a small mobile pumping unit, or sometimes hand-operated equipment.

a 200 m.p.h. cruising speed. This, together with night landings, will permit much more efficient planning of local services.

Sabena's four Doves, which handle such services as Matadi-Leopoldville, and the lake service from Costermansville to Goma, are described as technically very good but commercially not so good. This is because there is usually freight to consider as well as passengers, and in general Sabena does not wish to have anything more to do with small aircraft because of their low goods capacity. The services between Leopoldville and the small airfield at Matadi on the coast is for passengers only and is very popular for it gives a one-hour journey between the coast and Leopoldville as compared with 11 uncomfortable hours by rail.

A traffic problem to which there seems to be no immediate solution arises from the fact that while there is always plenty of freight and a full complement of passengers wishing to travel from Leopoldville westward, there are seldom full loads to be found on the return journey.

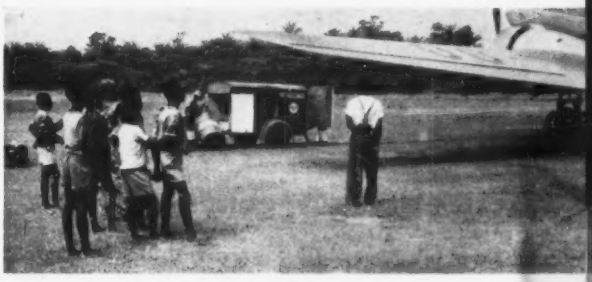
Provided a service terminates at Leopoldville, plans can already include a final landing after dark. Elsewhere in the Congo the lack of suitable diversions and the inadequacy of the met. system and of radio makes night flying too hazardous at the present time.

Fortunately the Congo is a rich country and an important scheme for airfield improvement is contemplated. Kindu airfield is high on the list for attention because of its importance as a diversion for Stanleyville and Usumbura. Other fields likely to be developed as intermediate stages are Luluabourg, Kongolo, and Coquilhatville. Of the northern-border fields, Libenge is already up to DC-4 standard and, because Juba in the Sudan is a relatively poor field and is felt to have a somewhat doubtful future, a new airport may be built at Aba just within Congo territory on a line between Stanleyville and Juba. This, incidentally, is in a gold-mining region.

Sabena's headquarters in the Congo are, of course, at Leopoldville, while branches of the organization, in addition to ticket office and essential airfield staff, are to be found at Elizabethville and Stanleyville. At the three main points mentioned, Sabena has also built attractive guest-houses for its passengers.

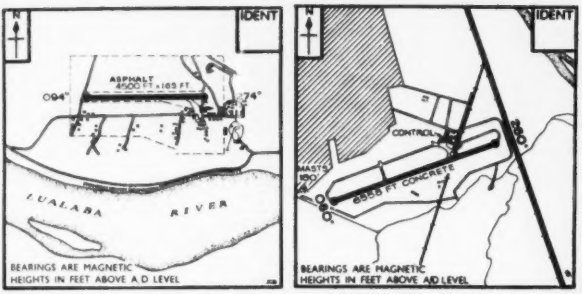
Leopoldville Airport was constructed on the site of the former N'Dolo airfield. (Its layout and dimensions are to be found among the illustrations—see page 808.) Now, because the need for improvement of air communications is fully appreciated, plans have been produced for a first-rate new airport of international class, which, it is hoped, will be built some 15 miles inland, at N'Gili. Before work can start in earnest, however, a road must be built to the site. There are people who feel that a scheme for co-operation with the French at Brazzaville, a few kilometres away on the northern river-bank, would be more sensible and economical, for here, too, it is planned further to improve the existing airfield, which is already used by trunk-route aircraft. It is also pointed out that a much-needed bridge across the Congo River could probably be built for less than the cost of the new airfield at N'Gili. On the other hand, Leopoldville would naturally like to have a first-class airport of its own.

In charge of Sabena's operations in the Belgian Congo is Major Gaston Dieu. During my visit to Leopoldville I made his acquaintance and heard from him many of the details of Sabena's operations and plans which are discussed above. He also told me of developments on the servicing side, and detailed the duties of the present fleet, which comprises sixteen DC-3s, two C-47s, four Doves, and three S-51 helicopters. The duties of the Douglas



(Above and below) Basankusu. The small building seems to shrink under the palms; American sedans are to be seen at all airfields.

(Below) The Congo's main airport at Leopoldville with the control tower, new Sabena engine-repair shop, and hangars as salient features.



Airfield plans of Stanleyville (left) and Leopoldville (provided by Aerad). (Right) A scene typical of the country over which many of Sabena's Congo services are flown. The Congo River, several miles wide, divided by islands, and surrounded by heavily wooded countryside.

"Flight" photograph

SABENA'S CONGO AIRLINE . . .

types and of the Doves have already been mentioned, but those of the helicopters, and of a Lodestar and other C-47s for whose operations Sabena is responsible, may be briefly mentioned here.

The first S-51—two others have not yet been assembled and put into operation—is operated under contract to the Congo Health Services, and is used for dusk-and-dawn spraying of the river banks in and around Leopoldville to keep down, in particular, mosquitoes and sandflies. Between three and four hours' spraying is done each day, using a 20 per cent D.D.T. and gas-oil solution. Spraying of this kind is becoming increasingly important in the Congo.

The Lodestar is concerned with Government mapping and photographic survey, and the two C-47s are also to be employed on these duties. One C-47, conversion and equipment of which is now complete, is to be used in a new spraying experiment to start at once, when, for the first time, an attempt is to be made to spray effectively large open areas of the Congo. This aircraft will carry some 3,600 litres of fluid, which will be released with the aid of six pumps. It is estimated that some 40 per cent of the C-47's flying time will be spent in spraying.

It is the aim of the Congo division of Sabena to become self-supporting so far as maintenance is concerned, and recently a great deal of progress has been made in this direction. Technically, the workshops at Leopoldville are well-equipped, but the buildings are rather inadequate, and with a new airport planned no one wishes to spend more money than necessary on new buildings and hangars, however badly they may be needed. In fact, one new hangar with a floor area of 246ft × 164ft (40,344 sq ft) has been approved for construction at the present airfield in order to deal with DC-4s, and not long ago a fine new engine-overhaul shop was completed.

So far as power units are concerned, Sabena can now undertake its own overhauls and also a number of others, under contract, for the French and Portuguese and for Government and private flying. At present Cyclone 1820s and Gipsy Queens comprise the main work in hand, and the capacity is approximately ten engines per month. The chief engineer informed me that Africans working as labourers, or on certain semi-skilled machining work, are employed in the proportion of two to one white engineer, and that one of their main virtues is their great patience.

Owing to the climate, and in particular to the continuous 90 to 100 per cent humidity, all power plants which are held in reserve must be cocooned. I was surprised to learn that, during maintenance and overhauls, no particular protection is considered necessary against dust, although every time an aircraft runs up during the dry season dense brown clouds are raised.

So far as airframes and equipment are concerned, corrosion is a real problem. With the DC-3s, a "float" of four wings is now maintained so that there shall be no undue delay during inspection and replacement. Recently the Dove OO-AWE was stripped right down to see how the airframe had stood up to conditions in the Congo. Everything was found to be satisfactory and in good condition.

The stores and spares organization is being improved and rearranged and the instrument-testing section is in process of expansion to take over more and more of the work which has so far been done in Brussels. Calibration and small repairs have been undertaken for some time past, but instruments for major overhaul are flown back to Europe.

Another new section which has recently been taken over from Brussels is concerned with furnishing and internal equipment. Finally, an important rearrangement and rehousing of the machine shop is in hand.

Apart from the complete Dove airframe inspection and the special C-47 for area spraying, to which reference has been made, interesting jobs which were in hand during my tour of the Sabena base included work on two Cyclone-engined DC-3s, which have extra large front freight holds, accommodation for 18 passengers and Sabena-designed rear loading doors sufficiently large to take a spare power plant; the assembly and testing under contract of a private Bell helicopter which is to be used in the swamp country for examination of papyrus—used in connection with the manufacture of cellulose; and the painting (when sufficient quantities of a suitable finish is available) of all cabin-tops in the now-familiar tropical white.

In the Belgian Congo employers are required to make themselves responsible for the welfare of their employees to an extent greater than in almost any other country. Without enlarging much upon this statement we may add that Sabena have separate medical centres for white and African staff, and employ three doctors and one dentist. They also provide lodgings and apartments for about 100 of their employees and are responsible for some 60 others who are on a waiting-list. The total staff is in the region of 1,000, of which Africans predominate in the ratio of approximately five to one.

Indicative of conditions on omnibus routes is the contention that a flight engineer in a Dakota crew is more important than a second pilot, for not only has he his job in the air but also he must supervise refuelling and loading; and, because there are no local ground engineers, he may also have to undertake *en route* servicing jobs. (At small airfields one sees only a white traffic clerk and native boys.) The normal Dakota crew comprises a captain, who is pilot; an engineer; a wireless-operator/navigator; and a native steward. To avoid racial complications outside the territory, services linking the Congo with other countries usually carry a white stewardess. From personal experience I can say that the Sabena aircrews seem to form themselves into teams with an excellent spirit, and that the African stewards do the job they are taught very well indeed.

On the Route to Leopoldville

My experience of Sabena operations in Africa took me through a period of doubt to one of admiration. It is important to have in mind a clear conception of the operational difficulties and also of the work that is actually being done; then, with this as a mental background, it is fair to compare the internal Congo services with those in Europe and America with which many people are now familiar.

First it must be remembered that the majority of local African

At Stanleyville are seen a DC-4 main-liner and, on the right, the Dakota which carried the author for most of his journey in the Congo.

"Flight" photograph

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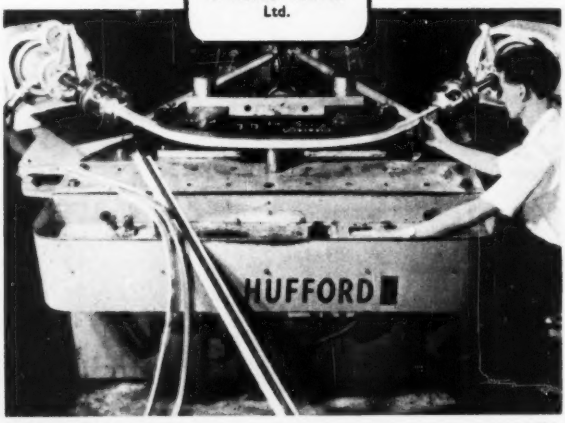
Hawker Sea Fury and Sea Hawk production. Photographs by courtesy of Hawker Aircraft Ltd.



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SABENA'S CONGO AIRLINE . . .

fields are no more than strips roughly levelled at a convenient point near a town. There is no all-weather surface or tarmac apron, and a heavy storm or a period of rain can put the strip out of action for hours or perhaps days. Airfield radio is somewhat primitive if it exists at all, and telephone services are most unreliable. For example, in some towns the lines are available for outgoing messages only during the morning, so later outgoing traffic must wait until the next day; incoming messages have to conform to the converse rule. Even some of the roads between towns work on this sort of principle, westbound traffic leaving on for example, even dates, while eastbound vehicles must travel on odd dates. Between Stanleyville and Leopoldville the telephone lines are better, and towns between benefit accordingly.

For navigation, flight information and met. in outlying areas, an aircraft crew will usually wait until they have taken off and started on course, then, with the aid of their own radio, ascertain the weather and airfield conditions at destination. There seems to be no met. briefing or route forecasting in the normal sense except at airfields handling transcontinental services.

Flight-frequency is not high on many routes, and one Dakota may spend up to a week running a daylight round-tour stopping service, feeding to and from a trunk route at, say, Stanleyville. There is no night flying, and some four towns can be served for freight and passengers in the same number of two-hour or two-and-a-half-hour flights.

If an airfield is u/s. the town either misses that week's service or a diversion is made from the nearest route. In these circumstances timetables cannot be relied upon, but if one enjoys the Spanish *mañana* mentality, as Congo conditions compel most of the inhabitants to do, a week's wait is no particular hardship.

When booking an air trip across the Congo at one of Sabena's European offices, connections should not be chosen which give less than a one-day gap between arrival and departure and, where possible, an open-dated ticket should be avoided, for it carries no priority nor is advance notice sent to the man preparing the passenger list. It is an advantage to book well in advance.

Offsetting these difficulties is the willingness of Sabena's staff and crews to improvise and accommodate a traveller when possible. If there is an aircraft going the right way, the chances are that everyone and everything will be packed in. However, is one misses a service through no fault of one's own—because, perhaps, the day has had to be changed at short notice—no sympathy should be expected. To put these remarks into better perspective and to avoid undue criticism of Sabena's operations, an example may be quoted.

Change of Plan

In London I had booked a seat from Entebbe in Uganda to Usumbura in Ruanda Urundi (a separate section of the Congo). The service was, according to the latest printed timetable, a weekly one each Sunday noon. On arrival at the airport I discovered that the service for that week had been changed (no reason given) to the previous day. There is no Sabena representative at Entebbe. My aim being to reach Stanleyville by Wednesday, other means of transport were sought, and the only possibility of reaching Costermansville, a stop between Usumbura and Stanleyville, between Sunday midday and Tuesday night was to charter a car or aircraft. The aircraft would have had to come from Nairobi and the cost could not have been less than about £75. The car for approximately 1,200 miles return and the driver's four nights away would have cost me about the same—provided it was for one passenger and light bags; a larger car would have cost quite a lot more. In fact, a Vauxhall Ten was offered for an estimate of £75 with no guaranteed day of arrival. As might be expected, the roads are mostly rough tracks and there are mountains to be negotiated with one-way sections controlled by boys who signal with drums.

At Nairobi, two hours' flying to the south-east (the wrong direction), there was useful work for me to do and there is a Sabena office. I therefore took the daily E.A.A.C. service—and, on arrival there, heard by chance that a Sabena special charter was taking meat through to Costermansville on the Wednesday morning. After some talk it was agreed that a solitary seat (I.C.A.O. requirement) should be installed and my carcass substituted for that of one chilled sheep. The extra fare of £10, Nairobi to Entebbe, was paid (I expect to get it refunded), tickets altered, and now I only should be a day behind schedule again, but there would be no time to spend at Usumbura.

Dakota freighter OO-AOU's crew of three, Capt. A. N. Persenaire, wireless-operator/navigator, and engineer-cum-loader, who acted as steward also, were most friendly, and I was provided with an excellent E.A.A.C. packed lunch. From time to time they came back to talk to me—all spoke English, and two had worked in or with the British Forces during the war.

To my surprise the ride was very smooth in spite of the widespread cumulus and occasional cu-nim over the mountains. With the help of a tail wind the flying time from Nairobi was a little under four hours. We refuelled at Entebbe because of the full load of meat, butter and eggs. And so I got back on to my planned route again.

"Flight" photograph

A Sabena sideline is the D.D.T. spraying, under contract to the Congo Government, of Congo river banks with the aid of S.51 helicopters.

Costermansville is beautifully situated at the southern end of Lake Kivu, and the strip—in this case tarred—is on a hillside a few kilometres outside the town. The runway is 1,100 metres (1,200 yd) long and it lies at an altitude of 5,270 ft. A daily (sometimes twice daily) Dove service runs to Goma at the top of the Lake, and the Dakota services north and south. There are some 32 scheduled movements a week. There are also one or two private aircraft—Piper Cubs and a Super Cruiser—belonging to the local club.

Costermansville as a town was a surprise. It might have been a modern resort in Belgium, or perhaps—by reason of the mountains and lake—Switzerland. The Royal Residence is a new hotel, in use but unfinished, which would be something to talk about even in a European city.

The roads—or, more correctly, the one long main street—was lined with new American cars, and the shop windows contained luxuries of all sorts such as huge refrigerators, sewing machines, and fancy clothes and jewellery. Prices are steep, as everywhere in the Congo, and money seems to be very free. The contrast with nearby East Africa is amazing.

I spent the short night worrying because the passenger list for the next day was full and I was not on it. However, I reported hopefully at 5.30 a.m. at the smart Sabena office under the hotel, and later at the airfield it was found possible to include me, for luckily two passengers proved to be baby girls of lap size. It may be added here that many babies and young children are taken by air, this being so much easier and more convenient than other means.

This omnibus flight, as they call it, set off southwards in the opposite direction to Stanleyville, and in a short time Lake Tanganyika with Usumbura on its northern tip was coming up ahead. We put down on a sand and grass strip, refuelled, off- and on-loaded as required, and were ready to fly north again in about twenty minutes *en route* for Irumu. It was getting very hot by this time, and on arrival drinks and sandwiches were served under cover.

Smooth, coarse grass forms the Irumu runway, which is sited in open scrub country. Shortly before landing we had passed Ruwenzori Mountain on our right, but cloud prevented us seeing much of it. Occasionally, on the next leg of the journey, we passed through well-developed cumulus which shook us up for a minute or two. Otherwise at just over 11,000ft—our average height—and 150kt it was very smooth and pleasant. The huge Congo River and Stanleyville came up almost together as our destination was reached.

Both the town and airfields are very different from the others I had seen. The airfield has a good tarmac runway, aprons, hangars, control buildings (see accompanying Aerad plan) and across the main road, the Sabena Hostel. Several DC-3s and a DC-4 were drawn up there. At mid-afternoon the temperature was the highest I had so far experienced.

The town is attractive and expanding rapidly, and the native population here seem to be more advanced than most African tribes. Until comparatively recently most were uneducated, primitive and wore no clothes, nor did they have any particular religion. Now great advances have been made, and large numbers work in the town, own best suits and bicycles, and copy the white man as far as possible. To talk of "working like a nigger" in Africa is, however, to be heavily sarcastic.

The Wanginia tribe of fishermen on the Stanley Falls keep themselves apart and, being more industrious than most, do very well. I talked to a head man who had just taken delivery of a new Hillman Minx.

At Stanleyville I chatted with Mr. Geubbels, the Sabena manager, who was having a very busy time because it was a national holiday.

Travelling in the Dakota since I joined it at Costermansville had been Sabena's Miami (U.S.A.) representative. Her film-star

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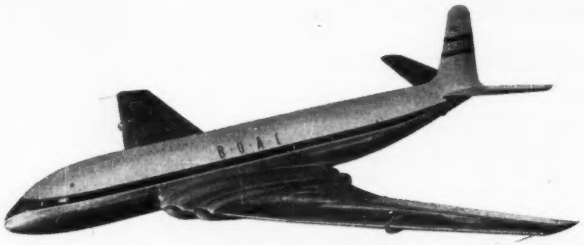
TALKING POINT



Some "Anti-Reactionary" Views on Britain's Lead in Air Transport Development

JUST how good is the Comet? No doubt there are a great number of airline executives throughout the world who, at this moment, wish they knew the answer to this leading question. The reference is not, of course, to the actual airborne performance of the Comet—the general figures are well known and proven, in the case of the Series I, during some 90,000 miles of overseas route trials—but rather to the problem of assessing its value in the light of its probable effect on air-transport economics. As is the case with most revolutionary concepts, the idea of introducing jet transports at their present stage of development—in the hope that they will prove to be money-makers—has come in for its fair share of argument. For while the Comet has many protagonists, there is yet an equally large proportion of civil-aviation thinking which still regards it with a certain scepticism.

Nevertheless, there is general agreement, even among its harshest critics, that in jet-transport development the Comet has established a hypothetical lead for Britain which may extend to anything between three and five years. However promising the American long-range position may be, the Comet thus has before it the prospect of at least two years of operation entirely free from foreign competition. The main point on which most of the sceptics remain to be convinced, however, is the commercial justification of introducing the Comet into scheduled service with its present range and speed characteristics. In view of the fact that over three-quarters of the world's commercial aircraft are of American manufacture and that the greater proportion of the air routes are in American hands, it is hardly surprising that most of the reluctance (or perhaps it should be called "wariness") to admit that the Comet is, in fact, a milestone heralding a new era, should spring from American sources. Even so, several European and Dominion operators with long-distance over-sea networks have also allied themselves with this attitude.

Following a recent visit to this country, a C.A.B. survey group estimated that in order to accumulate the essential early experience necessary to foster sound designs and avoid costly and hazardous errors in operation, Britain had been willing to pay a total of £140,000,000 on civil transport development since 1943; a considerable proportion of this had been allocated to jet transports. One source has reported the British Government's stake in Comet development costs to be about $4,200,000 per aircraft, as compared with an estimated selling-price return for each Series I version of $1,260,000. (It may be remarked here that there is a tendency abroad to lump together the development costs for the Ghost military turbojet and the D.H. 108 research aircraft and charge them all up against the Comet. There can have been few large aircraft of any nationality that did not benefit from military airframe or engine developments.) The same group considers, moreover, that in allowing Britain to attain this lead, the United States might still not have lost an irretrievable amount in competitive position, provided that immediate steps are taken "to proceed with the intensive testing of available turbine-powered aircraft" and "to start the development of advanced types." American factions are of the opinion that what we have gained in civil-turbine development we, nevertheless, stand to lose in operational efficiency by adhering to intermediate aerodynamic designs. It is alleged that *once* the U.S. programme gets under way, its more advanced aerodynamic, structural and production knowledge will result in superior jet transports.

As far as is known there are, at the moment, two U.S. jet-transport designs under consideration—the Boeing 473 and the Lockheed L-193—both of which bear striking similarity of design to advanced military types now being produced by the same respective manufacturers. Both of these machines are intended to give a considerably higher performance and greater passenger-capacity than either the Comet I or II, but unless the U.S. Government gives them high priority and their construction starts forthwith, it will certainly be at least five years before either can see service.

Apart from one or two smaller American companies (such as Overseas National Airlines) that have shown interest in the Comet for immediate operations on limited medium-haul networks, most of the American operators stand firm (or at least together) in their belief that Britain's lead is not nearly as formidable as might at first appear. Their arguments are based on the hypothesis that for the first time in aviation history the world is faced with a period ahead when, for compressibility reasons, design speeds of transport aircraft will remain stabilized at about 600 m.p.h. for ten to twelve years. American manufacturing effort is currently being directed towards achieving this speed as a commercial feasibility, and the airlines are confident that the first transport in this class will be of U.S. design.

The Comet's Life-span

During the interim period until such types are available, it is considered that high-capacity machines of DC-6B and Lockheed L-1049 class (with, ultimately, conversion to turbo-prop power) are capable of yielding a degree of productivity which will ensure that the critical economic balance of the U.S. airline industry remains well "in the black."

One point which the consensus of American opinion stresses is that because the desired 600 m.p.h. cruising speed is 100 m.p.h. in excess of anything envisaged for the present series of Comets, these latter aircraft will virtually become obsolescent in about five years. To embark upon the expense of acquiring Comets now, is, in an American view, simply "not worth the candle." Nor, in their opinion, would the cost of development of a similar American design have been worthwhile.

Exactly when and what will emerge from the construction sheds of U.S. manufacturers is still a highly contentious point, but current information has it that something in the 600 m.p.h. class could be in service by 1956. Even under our present production schedule it may, admittedly, be 1954 or even 1955 before the Avon-powered Series II Comets are ready for service. Without added impetus, too, the preparation of faster and larger-capacity Comets than either the Series I or II would seem to be several years distant. It will be interesting to see whether or not both the U.S. and Britain, with their different approaches, eventually reach the 600 m.p.h. high-capacity long-range stage together.

This is one of the major considerations on which the current U.S. attitude to the Comet is based. Most of the Americans, together with several other foreign operators, are

TALKING POINT . . .

convinced that the next major step in the speed of airliners must, in fact, be a jump from 300 to 600 m.p.h. for high-capacity machines. Great Britain, represented by B.O.A.C. and with the support of French and Canadian operators, is content with an intermediate step of between 450 and 500 m.p.h. at medium capacities.

In assessing the wisdom—or lack of it—implicit in the American attitude, it hardly seems necessary to point out that, even if conditions are such that Britain can only produce a 600 m.p.h. transport at the same time as America, the operational experience which will, by then, have been acquired with Comets will still count for a very great deal.

No one is yet in a position to speak with any degree of accuracy on Comet economics, but there are, nevertheless, a number of basic factors which give a broad hint of the way in which they will influence airline balance-sheets. Concerning direct operating costs, some figures recently calculated by Overseas National Airways (who had made plans to purchase two Comets) can serve as a guide to what may be expected. Assuming the obsolescence period to be eight years with 20 per cent residual value, an "operating weight" of 62,500 lb, a payload of 10,000 lb and other assumptions conforming to standard U.S. practice, O.N.A. envisaged Comet operations on routes such as New York-Los Angeles or New York-Miami at $406 per hour. With regard to ton-mile costs, studies by K.L.M. have shown that the Comet could probably operate at a lower figure even than the L-749A Constellation; because of its limited seating capacity, however, its cost per passenger-mile is not so favourable. K.L.M.'s president, Dr. Albert Plesman, speaking recently of his company's decision to order Super-Constellations, said that at the present stage of development he considered that this was a "better bet" than the prospect of waiting for the Mk II Comets. He envisaged the operating cost of the Comet at 2½ cents per passenger-mile for long-range work which, he said, was hardly a commercial proposition when it was considered that a Super-Connie could offer 1½ cents per passenger-mile on the same route. These figures, however, are purely conjectural and much would depend upon the state of development of the Avon and the Comet airframe, and upon the experience which will have been acquired by the time Avon-powered Comets are ready for service on the transatlantic and other routes envisaged by K.L.M.

B.O.A.C. is not yet willing even to hazard a guess at the passenger-mile costs which will be experienced, but the Corporation is confident that it has taken the right path in choosing the Comet. The Series I machines, being only 36-seaters, are not likely to prove very remunerative, but high hopes are entertained for their Avon-powered successors which, it is hoped, will not only confer a range increase of perhaps 1,000 miles, but also some augmentation of cruising speed. The gross weight is likely to be increased by upwards of 10,000 lb. Specific fuel consumption of the Avon is appreciably less than that of the Ghost; thus the ton-mile costs are likely to be materially reduced. As it has yet to fly, it would be unwise even to guess at a passenger-mile cost for the Series II, although with its exceptional utilization capabilities, it should prove to be a keenly competitive aircraft, even when matched against the higher capacity L-1049s and DC-6Bs on long-distance routes.

However the initial passenger-mile costs compare with those of its immediate competitors, the overall concept of the Comet's operation, namely, that higher speed and higher utilization must yield a multiple economy, will obviously become more and more evident as operating techniques improve in the light of experience. Because of this country's decision to operate Comets now it is also probable that, until the U.S. can fully catch up with Britain's lead, the developed British jet transports will prove cheaper in operation than their American counterparts, assuming them otherwise to have the same payload and performance characteristics. This in itself may well be an important factor in influencing some U.S. airlines to seek British equipment rather than have to contend with a lengthy, and costly, period of scheduled service usually associated with the introduction of a new type of aircraft.

SABENA'S CONGO AIRLINE

(Continued from page 809)

appearance had caused a small stir at each stop, and the attention to passenger welfare from the younger members of the crew was quite remarkable.

At various points *en route* I was cryptically told to "save my questions for God, who will be at Leopoldville." The mystery was solved when I subsequently made the acquaintance of Major Dieu, head of Sabena in the Congo, and to whom I have already referred.

Refuelling at the various small stopping points was quick and efficient. Ladders were put against the wing leading-edges by one boy, others manhandled either a trailer-type pump or a two-handed affair up to the nose; still more rolled-over the large metal drums in which the fuel is stored. Big filters are rested on the wing, with an outlet spout for the tank filler. When all is done the engineer of the crew dips the tanks to make sure the native boys have not made any mistakes.

On the Stanleyville-Leopoldville run I took the 0800 hr stopping service which follows the Congo River and visits Bumba, Lisala, Basankusu and Coquilhatville. By midday it was very hot indeed and, after standing, the engines protested a little at starting-up, tending to get over-rich. At Basankusu, boys turned an extinguisher on the exhaust.

On the local runs coloured stewards and natives on ground duties do a very good job. Women took over the paper work for tickets and manifests at places like Lisala and Basankusu. I noticed that, although the weather looked reliable enough—a half cover of alto-stratus and some residual low stratus near the river, with some small cumulus here and there—the crew were 'phoning ahead for met. gen at the next stop.

In the aircraft the ventilation was just about adequate in the air, but to start with—what with vegetables, including leeks, and other freight, over-perfumed women and the late presence of native porters—the atmosphere was a trifle thick. Even so, the old Daks still give a very comfortable ride.

(This concludes "African Notebook": Next week, however, we hope to publish some notes on met. in the Belgian Congo.)

CUPS THAT CHEER

A RECENT addition to the appliances for aircraft catering made by the General Electric Co., Ltd., is a 1½-pint hot-cup. Although designed primarily to supplement other facilities by permitting the rapid service of beverages to passengers' individual orders, two of these cups constituted the only means of providing hot refreshments that it was practicable to instal for the recent North Pole flight of the R.A.F. Lincoln *Aries*. In this way the 11 members of the crew could be supplied with hot drinks or soup at any time during their 24 hours over the Arctic. The element has a rating of 500W at 28V d.c., and it was found even in the exceptional conditions of the Polar flight that the contents of the cup were heated to boiling in approximately 9½ min.

An important feature of the hot-cup is the ease with which the element can be replaced if renewal is necessary. A cup of this type is included in the galley equipment of each of the new Comets, and two are carried in the galleys of the Hermes aircraft of B.O.A.C.

FORTHCOMING EVENTS

Jan.	11.	A. and A.E.E., Boscombe Down: Contractors' Dinner.
Jan.	18.	Helicopter Association: "A Review of Helicopter Patents," by L. H. Hayward.
Jan.	18.	Institute of Navigation: "Navigational Errors," by W/C. E. W. Anderson, O.B.E., D.F.C., A.F.C.
Jan.	19.	Aircraft Recognition Society: Hurricane Trophy Competition.
Jan. 19-20.		Vintage Aeroplane Club: Rally.
Jan 28-Feb. 1.		Institute of the Aeronautical Sciences: 20th Annual Meeting, New York.
Jan.	29.	Society of Instrument Technology: "Mechanical Consideration in the Design of Servo Systems," by Prof. A. Tustin.
Feb.	11.	Institute of Transport: Brancker Memorial Lecture, by Capt. E. D. Clarke, M.C.
Feb.	15.	Institute of Navigation: "Navigation Aids for Military Aircraft," by S/L. D. Bower.
Feb.	20.	British Institution of Radio Engineers: "Search Radar for Aircraft," by P. L. Stride.
Feb.	22.	Helicopter Association: "Helicopter Power Plants," by A. Graham Forsyth, B.Sc., F.R.Ae.S.
Feb.	23.	Society of Licensed Aircraft Engineers: Main Lecture: "Some of the Responsibilities and Problems of an Airworthiness Authority," by R. E. Hardingham, O.B.E., F.R.Ae.S., M.S.L.A.E.
Mar.	21.	Helicopter Association: "Recent Helicopter Research Investigations," by W. Stewart, B.Sc.

ENTERPRISE in ENGINEERING

A. Cdre. Banks on "the Approach to the Job": on Early Engine Development: and on the Memorable Example of Britain's Success in the Schneider Trophy Races

THIS is a lecture of an unusual kind. Making his presidential address to the Junior Institution of Engineers, Air Cdre. Banks first spoke of some general aspects of the engineer's occupation, and of right and wrong approaches to it. He then went on to compare early and modern methods of aircraft-engine development and, finally, to recount in considerable detail the story of an effort that was to have a profound influence on engine (and airframe) design for many years to come—the preparation of the Rolls-Royce R engine for the Schneider Trophy Races. These two latter sections of the address are reproduced here in full, and we think that readers will find the Schneider story, in particular, to be entertaining as well as instructive.

ON his induction last Friday, December 14th, as president of the Junior Institution of Engineers, Air Cdre. F. R. Banks, C.B., O.B.E., M.I.Mech.E., F.R.Ae.S., F.Inst.P. gave as his presidential address a lecture entitled *Enterprise in Engineering*.

For the first half of his talk the new president concentrated on giving some encouragingly downright advice to those young men who are on the threshold of engineering careers. He said that war and its unsettled aftermath had had a depressing effect upon all people; and great harm had been done to young people by upsetting, and sometimes entirely removing, the home influence. There was less self-discipline today than there was before the First World War or even in the period between the wars; and this in itself had contributed in no small way to unrest and the "don't care" attitude.

When some measure of industrial discipline was restored, when grown men ceased to act like spoiled children if things were not exactly to their liking, and when they refused to follow irresponsible agitators, then this country would have some chance of reshaping itself as the major Power for good in the world. We were, in fact, a major Power, and still had considerable world influence; but this had been the result of energy built up and stored in the flywheel during the centuries. We should not let the flywheel run down.

Many were apprehensive of the Welfare State concept and the attitude taken up by some that "the world owes me a living." These in combination too often resulted in the outlook that one joined a firm for what one could get out of it rather than for what one could contribute to its growth and future prosperity. It remained to be seen whether or not the cradle-to-the-grave philosophy, and the conditions which prevented the individual from materially bettering himself, offering no incentive or chance of appreciable financial improvement, would lead to mass mediocrity.

This was said to be the age of the common man, but A. Cdre. Banks said that he did not believe in the common-man idea and hoped that he was not talking to the common man on that occasion. All had to have equal rights and opportunities, but those who made the fullest use of these should be allowed the rewards and benefits of their better effort, and we had all to endeavour to be uncommonly good in our respective jobs. Only by ignoring subversive ideas and restrictive practices could we improve things for ourselves and our children.

Engine Development Then and Now

The new president devoted the second part of his talk to the aviation engine as being representative of a particular class of engineering in which he had had nearly thirty years' experience. (After conducting experimental work on engines during the nineteen-twenties, A. Cdre. Banks joined the Anglo-American Oil Co. as aircraft-engine specialist and later transferred to the Associated Ethyl Co., as technical manager and chief engineer, positions he still holds; during the Second World War he was successively Director-General of Aero-engine Production and Director of Engine Research and Development at M.A.P.)

The high-duty aviation engine [said A. Cdre. Banks] differs in many respect from other types of prime mover. First, it must be of the smallest bulk and weight possible for the power it produces. Second, since there is little or no finality in aviation, there must always be the urge for progressive engine improvement in order to meet the demands for better aircraft performance. Third, the development of the engine is very costly and has now to be supported nationally through the medium of Government contracts.

Although the first flights by the Wright brothers, in 1903, were the start of powered flight, the real aviation era commenced in France, in 1909, where a number of ingenious engines were designed and built. In those days, the whole conception of an aviation engine came almost entirely from the brain of the individual engineer. And success, in the form of orders, rewarded the man who better combined the right degree of inventiveness with good detail and mechanical design.

Today, there are many involved in the evolution of a new engine; but the importance of the individual, as the head of the firm or as its chief engineer, has in no way diminished. Since the modern engine depends for its success upon the efforts of a team of specialists, they must look to the man at the top for proper direction and co-ordination.

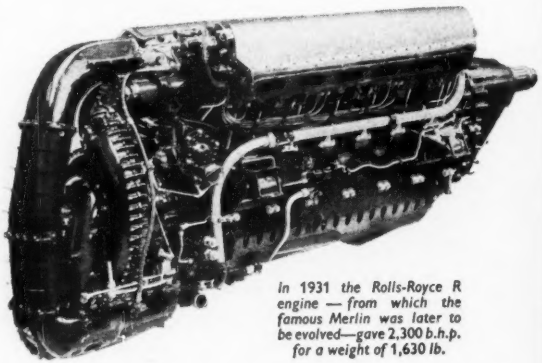
The value of good engineering development began to be appreciated during the middle of the first World War. Previously, an engine of promising design was often condemned and quickly discarded because of sheer lack of experience and technique to cure continued or frequent mechanical failure. Even after this first appreciation of the necessity for developing an engine out of its troubles, some ten or fifteen years were to pass before it became a fully developed art or technique. And, today, there are still firms who are not yet alive to the importance of intensive development.

Since it takes four or five years to design and develop a modern piston-engine or gas-turbine up to the type-test stage and readiness for production, the value and importance of proper and intensive development, to avoid costly failure, cannot be over-stressed.

It is a truism to say "there is nothing new under the sun," and such developments as fuel injection, airscrew reduction-gear and the metal airscrew were all first thought of and tried in 1909. For instance, the Antoinette engine built in that year was a 90 deg. vee-type eight-cylinder liquid-cooled, or, rather, steam-cooled engine. It had direct fuel injection into the inlet ports in place of a carburetter. Its radiator or condenser was in the form of a series of tubes arranged along the fuselage sides of the Antoinette monoplane. This engine was fitted with a metal airscrew, the blades of which could be adjusted, on the ground, to give optimum pitch setting.

Another ingenious engine of that time was the Gnome, the cylinders of which rotated around a fixed crankshaft. The Gnome, with other rotary engines which followed, was also used in the early fighters of the first World War and, for many years afterwards, in training aircraft. At about the same time came the Anzani and the Salmson, both static radial engines, the latter having liquid cooling.

Also among the engines built in the same period was the Renault, a 90 deg. vee-type eight-cylinder air-cooled engine. The Renault had fan cooling, the air being directed by ducts from the fan to each bank of four cylinders. It was probably the first aviation



In 1931 the Rolls-Royce R engine — from which the famous Merlin was later to be evolved—gave 2,300 b.h.p. for a weight of 1,630 lb.

engine to have a reduction gear, since the airscrew was driven directly from the camshaft and, therefore, ran at half-crankshaft speed.

It is interesting to note that steam or evaporative cooling was tried many years after the Antoinette engine, between the two world wars, but was discarded on the grounds of impracticability. In the case of fighters, when indulging in aerobatics, it was found that the steam went where the water should have been and *vice versa*.

Today, the piston engine is either air-cooled or pressure-liquid-cooled. In the latter case, the liquid is usually a blend of about 70 per cent water and 30 per cent ethylene glycol. The pressure system and the glycol content permit higher temperatures to be attained without boiling or loss of coolant—avoiding the use of an oversize radiator, which was previously necessary for operation in tropical conditions and for the relatively short periods of high-power running during the take-off and climb of the aircraft. This development which resulted in a much smaller radiator, has brought about an important reduction in drag. The use of glycol also depresses the freezing point of the coolant.

The gas turbine, particularly the turbojet, has the disadvantage of a relatively high specific fuel consumption. While a considerable improvement, of some 20 per cent, has been achieved during the ten years of this engine's existence, still greater improvement must come if it is to be fully competitive in all fields of aviation. But this is in sight and will be realized in the not-too-distant future.

The gas turbine consumes an enormous amount of air, some of which is burned with the fuel and all of which goes through the engine. An engine such as the Sapphire, which gives 7,200 lb thrust, consumes about 199 tons, or over five-and-a-half million cubic feet, of air per hour. It will be appreciated, therefore, that a difference of one or two per cent in the efficiency of processing this large quantity of air—in taking it into the compressor, raising its pressure, burning some of it with fuel and then expanding it through the turbine and nozzle,—can have a profound effect upon power and fuel economy, or overall efficiency.

In consequence, the design and development departments of the firms making these engines now include a number of personnel who understand, or are alleged to understand, the behaviour of air under all such conditions. These aerodynamicists work closely with those engaged upon the mechnical design of the engine.

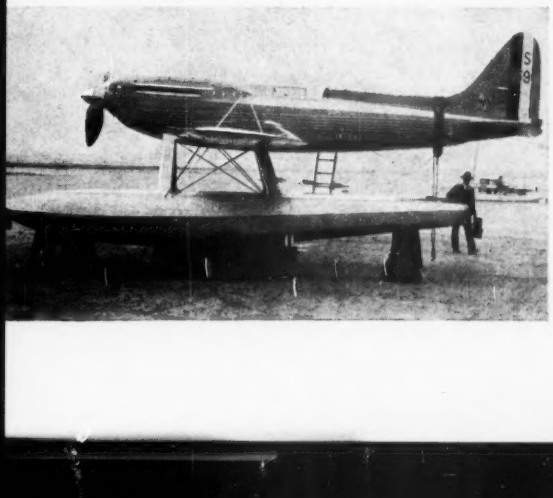
It takes many weeks to do the calculation for the design of axial-compressor blading.

The gas turbine demands good mechanical design and, at first sight, it might appear more simple in conception than the piston-engine; but it has considerable and peculiar problems of its own. For instance, the thermal and material problems of the "hot" end of the engine (the turbine blades and the disc) are more severe than any encountered in the piston-engine, and they demand great attention from the designer and the metallurgist in their proper handling and solution. Gas-turbine design can, therefore, offer considerable scope for individual ingenuity.

Even today, the aviation engine represents an engineering art rather than an exact science; and those who build such engines must have a good understanding of the importance of timing. That is to say, they must know how vital it is to have the right engine available at the right time. An even better engine, potentially, than the "right" one will not be wanted if it takes too long to materialize, and if the aircraft designer cannot depend upon having it when he wants it.

This matter of timing, coupled with good engineering development, is still too little appreciated or understood, and it marks the difference between the successful and the unsuccessful engine manufacturer.

With its closely cowled power unit, the Supermarine S.6B had lines which, in the opinion of many, have never been surpassed



[*At this point the lecturer went on to tell the Schneider Contest story referred to in our introduction. In one sense it formed a commentary on the opening section of his lecture for (as he pointed out) it was an excellent example of the influence of good leadership and good team-work. It was also an illustration of the most effective use of money at a high rate of expenditure—in some other quarters, comparable amounts had been spent piecemeal, and over longer periods, with the achievement of little or nothing.*]

It was in 1927 [said A. Cdre. Banks] that the British Government decided, for the first time, officially to support a team of R.A.F. pilots and aircraft for the Schneider Trophy Contest. This team in the same year, was successful in winning the Trophy from Italy, at Venice. The contest was won at an average speed of 281 m.p.h. by a Supermarine S.5 seaplane fitted with a high-compression (10 : 1) unsupercharged and geared Napier Lion engine, giving about 880 b.h.p.

In 1929, with Italy as the challenging country, the Air Ministry realized that the Lion engine had reached the limit of its development in unsupercharged form, and they instructed Napier to develop it as a supercharged engine. But, even so, it was appreciated that the power might still be less than that required for the forthcoming contest. Therefore, the Ministry asked Rolls-Royce to develop an engine of considerably greater power.

The basic engine, chosen by Rolls as the most suitable for developing in racing form, was their Buzzard or H type. This was a 60 deg vee-type 12-cylinder, liquid-cooled engine of 6 in x 6.6 in bore and stroke, having a cylinder capacity of 36.7 litres. The H engine, in its normal miltary form, gave something over 800 b.h.p.

By some detail redesign of connecting rods and reduction gear, etc., and an entirely new and larger supercharger to provide more air at high boost, and by increasing the engine speed, this first racing or R engine developed more than 1,800 b.h.p. at 2,900 r.p.m. The supercharger design was interesting in that it had a double-sided rotor, in order to keep the overall engine bulk or envelope within that required by Supermarine for their machine. Even the engine camshaft covers on the cylinder blocks were shaped to conform to, and form part of, the cowling.

The combination of the Supermarine S.6A seaplane and the engine won the 1929 Contest at an average speed of 328 m.p.h. The same machine then raised the world air-speed record to 357 m.p.h., immediately after the event.

The 1931 Achievement

Early in 1931, with the Italians again expected as challengers, there was considerable indecision regarding our participation in this event, which had now assumed considerable national and international importance. The Government of that day at first decided, on the grounds of national economy, not to support an official British team, but were shamed into reversing their decision by the patriotic Lady Houston who guaranteed, and gave, £100,000 towards expenses.

All this palaver and uncertainty, however, cut time very short for the preparation of machines and engines; and, literally, there were only little more than six months available before the date of the Contest. Therefore, Rolls were committed to the improvement of the 1929 engine, to reach the target power of 2,300 b.h.p. Parallel with this work, it was necessary to give the High Speed Flight of the R.A.F. a sufficient number of engines and aircraft with which to keep in training and practice. The machines used for this purpose were the old S.5s, and the S.6As of 1929.

A more or less arbitrary figure of six hours' flying time was decided upon for the maximum life of the practice engines; after which Rolls would send, to the team's base at Calshot, a reconditioned engine and take back the time-expired engine to their Derby works for overhaul. This organization worked like a clock. There was a Rolls team of engineers at Calshot, in permanent attendance, to look after the installation of the engines, their running and removal. The running time, of six hours, was taken to include bursts of full power. It was estimated to be the equivalent of one hour at full throttle on the test bed.

Since rail transport, for delivering and returning engines, would have been too slow and tedious, Rolls-Royce fitted an old Phantom I car chassis with a cradle to take an R engine. This used to do the journey between the Derby Works and Calshot in phenomenal time; and I well remember the consternation of all when the police once caught this equipage going through a small village at a quiet eighty!

I was privileged to help both in the 1929 and 1931 preparations, and was charged with making up a suitable fuel cocktail for these engines. It was a most inspiring time for all concerned, largely because of the energy and drive of the team leader and then head of the Rolls experimental department, Mr. Hives—now Lord Hives, the present chairman and joint managing director of Rolls-Royce.

His energy and foresight, and a "sixth" engineering sense, were an example to all and have stood the firm, one might even say

ENTERPRISE in ENGINEERING . . .

"institution"—in good stead ever since. Never have I seen engineers tear into a job as did that Rolls' team.

There was considerable, if well-concealed nervous tension when it came to putting the new engine through its official acceptance test. The Air Ministry requirements were the successful completion of a run of one hour's duration at full throttle at the pre-ordained sea-level power. This, it was considered, would amply cover the contest conditions, plus something over.

With only about five weeks remaining before the contest, the first modified R engine of increased power was submitted to the acceptance test. It broke a crankshaft after about 34 minutes' running! The engine was whipped off the bed and was in its component parts in about an hour. The history of the crankshaft was checked, and it was found that it had already done some hours of experimental running. Another engine was therefore built, having an entirely new crankshaft.

The engine was put up for the hour's run and, this time, after running perfectly for 58 minutes, the shaft broke again. It was on the eve of August Bank Holiday, with the contest only about a full month away.

Since the crankshaft of any engine is a somewhat basic component and there was obviously no time to change its design radically or that of the crankcase and bearing housings accommodating it, it was decided to strengthen the shaft merely by leaving more material in the hollow pins and journals. That all the steel-works in Sheffield had then shut down for the Bank Holiday did not deter Rolls, and the manager of their experimental machine shop went to Sheffield and got the crankshaft-forging people to work over the holiday and produce one forging ready for machining at Derby on the Bank Holiday Monday—to be followed by further forgings within the week.

Trophy Won Outright

As a result of this effort, the engine was put through a successful acceptance-test run in about one week from the date of the final crankshaft failure. A maximum power of 2,350 b.h.p. was obtained at 3,200 r.p.m., for an engine "dry" weight of 1,630 lb or 0.7 lb b.h.p. This power was equivalent to more than 1 b.h.p. per cubic inch of piston displacement.

Since the Italian challengers did not materialise, due to their unreadiness, the Supermarine S.6B, fitted with this engine, won the Trophy outright at an average speed of 340 m.p.h.

The Supermarine seaplane also had many interesting technical features. It has surface cooling for the engine, where, instead of the conventional radiator, the coolant circulated between the double skin of the light-alloy wing covering. The hollow tail-fin became the lubricating-oil tank and cooler combined, the oil being led to and from the engine by surface tubes arranged along the fuselage sides of the machines.

Since there were no variable-pitch or constant-speed airscrews in those days, the pitch of the metal airscrew then fitted was set for maximum performance of the engine in the air. Therefore, the airscrew was stalled and inefficient in the take-off-condition. Viewed from the side, it looked like a paddle-wheel, since it had a pitch of, approximately, 19ft 6in for a diameter of about 9ft.

When starting the take-off procedure the pilot had to face out-of-wind, because the airscrew torque could not, at low forward speed, be held or counteracted by the rudder. This out-of-wind allowance was so judged that the subsequent swing brought the aircraft into wind—sufficient speed had then been gained for the rudder to become effective. In order to help alleviate this effect one float was made larger than the other, and it also held more fuel. But these machines required considerable skill and practice on the part of the pilot, both for take-off and landing.

The take-off I have already described, but the landing was equally tricky; once the pilot was on his approach path, the machine "floated" for a considerable distance before touching down and, it also had a "nose up" attitude in the glide, so the pilot was practically blind to any obstruction there might be on the water in his landing path. As these take-offs and landings were conducted on Southampton Water, the pilots had to contend with many hazards in the form of small sailing vessels and motor boats, and the wash of big Atlantic liners.

The postscript to this final Schneider Trophy Contest is worth mentioning. After the event, it was naturally wished to wind up the proceedings by an attempt on the world air-speed record. But, in the opinion of Hives and others, this had little attraction unless the speed were raised to 400 m.p.h. or over—399.9 m.p.h. would not be interesting; it had to be at least 400 m.p.h. Therefore, it was necessary to step up the power of the engine to about 2,600 b.h.p.; and the only quick way to do this was by the use of a special fuel.

In the meantime, a further difficulty presented itself. The Air Ministry wished to remove the High Speed Flight from Calshot without delay and reinstate the station as a flying-boat base; which meant an immediate attack on the record with the existing Contest engines and fuel. This would inevitably have resulted in a speed below the 400 m.p.h. target. While the arguments and pleadings for more time were going on, Rolls-Royce were quietly and quickly preparing an engine for the record. On account of the short time available, there could be little mechanical modification; but stronger connecting rods were fitted, to deal with increased engine speed and loading.

The engine was built and fuel tests commenced. By using a high proportion of methanol (synthetic methyl alcohol) in the fuel, it was possible to raise the power considerably—at the expense of fuel consumption. The alcohol acted as a liquid charge cooler and reduced the temperature-rise through the supercharger, allowing a greater charge weight to enter the engine cylinders. In the first tests, the supercharger gear-ratio was raised to permit higher boost; and this, together with the fuel, gave a maximum power of over 2,800 b.h.p. But such a large power increase proved excessive for the engine, and some of the cylinder holding-down bolts fractured. Therefore, the original blower gear ratio was restored and the power reduced to 2,600 b.h.p., or about 250 b.h.p. more than that of the Contest engine, but sufficient for the record.

During the tests we found that the engine appeared to be starved of fuel, despite the increased jet size to accommodate the high alcohol content. It was eventually discovered that the total flow-rate through the jets was larger than the amount of fuel the pump could deliver, so the ratio of the fuel pump driving gears had to be increased. This happened one evening, when the Rolls machine-shop staff had already gone home. A messenger was sent to find the senior gear cutting specialist, who had gone out for the evening. Pubs and cinemas were scoured and he was eventually located—and came back to the works to labour all night, cutting new gear blanks In about twenty-four hours, the engine was running at the required power. A few days later it had completed a bench test, to simulate six runs up and down the official three-kilometre speed course, and was ready for delivery to Calshot.

In the meantime, the Air Ministry had agreed to stay their hand and delay, by a week or ten days, the handing over of the Calshot base to the flying-boats.

The engine was rushed down to Calshot and installed and, within a week, the air speed record had been raised to 407 m.p.h.

I often wonder whether the Air Ministry were not somewhat surprised to find an engine of increased power so quickly available after giving their permission for this record attempt.

The lesson to be learned from this story is that nothing worthwhile can be achieved in life without effort and some risk; and outstanding success requires enthusiasm in addition to experience and ability.

That Schneider Trophy experience was responsible for the continued effort and success of the firm of Rolls-Royce; and it gave to this country its best fighter engine, and one of the best bomber engines, of the war—the Merlin.

SPECIALIZED COMMUNICATIONS SERVICE

LAST week we published a brief note concerning the firm of Racal, Ltd., which was formed last year to provide specialized service in the communications (especially radio and radar) field. This service includes planning of facilities, selection and provision of equipment and spares, despatch of installation engineers to any part of the world, and training of communications staff.

In addition to the central organization at the London office (41, Kingsway, W.C.2) a separate company has been formed to undertake the manufacture of specialized communications and other radio equipment. Its factory, which is at 274, Worton Road, Isleworth, Middlesex, has an area of approximately 5,000 sq ft of manufacturing space in a modern building constructed in 1948.

The works are equipped with the necessary machine tools for all types of cabinet and chassis work, in addition to the necessary equipment for production of quantities of items such as radio receivers, test gear, etc. An initial order for 500 special carrier receivers for a large British company engaged in broadcast relay services is at present in hand, together with the manufacture of prototype control desks to specifications received from certain overseas and British aviation authorities.

The factory is equipped to undertake the fitting of vehicles with radio or radar equipment, either for training or operational use; in addition it can overhaul mobile and static radio/radar installations. It will also serve as the base for field technicians engaged in outside installation work. The chief engineer is Mr. D. A. Webb, who was until recently with the Ministry of Civil Aviation, where he was concerned with the installation and development of systems such as early warning radar, centemetric systems and navigational and landing aids.

Two subsidiary companies of Racal, Ltd., have also been formed in Canada.

TURBINE STARTING

Mk 3 Plessey Starter for Nene 4 Turbojet

IT was in the September 29th, 1949, issue of *Flight* that first mention was made of the Type T.S.C. 50 turbine starter then introduced by the Plessey Co., Ltd., of Ilford, Essex. Now, with the development of the Mk 3 version of the T.S.C. 50, although the fundamental design remains the same, various values of performance data, speed ratio and weight have been altered.

Specifically designed for use in the Rolls-Royce Nene 4 turbojet, the starter is itself a miniature high-speed gas turbine, the gas production function of which is vested in percussion-cap cartridges. With a total energy output of 64,000ft lb. exerted during a working period of two seconds, the starter provides rapid and yet smooth acceleration which enables a start-to-engine-idling speed to be made in under ten seconds. The installed weight is 54.7 lb.

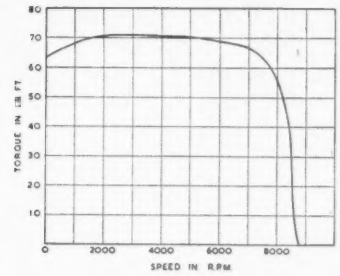
Firing of the charge is accomplished by means of the starter control panel, the depression of a simple push-button in the pilot's cockpit initiating the starting cycle. The panel then controls the sequence and timing of the various operations, including the closing of the throttle by-pass when the engine has reached normal idling speed, and also prevents damage resulting from attempts to start an engine already rotating at high speed.

The starter embodies a nest of six cartridges radially disposed around the fore part of the unit with their axes parallel to that of the unit. Three starts can be made without re-loading, as complementary pairs of cartridges are fired simultaneously to direct their gases through two diametrically-opposed nozzles giving on to the first turbine stage. A contra-rotating turbine wheel system is used, so that the interposition of a stator stage between the rotors is obviated, and the energy extraction quality of the second stage wheel thus left unimpaired.

Drive from the turbine wheels is given through a multi-stage reduction gear to the output drive-shaft, the peak speed of which is 8,750 r.p.m., and corresponds to a turbine assembly speed of 38,000 r.p.m. The mounting face of the starter and serration of the output drive-shaft are to S.B.A.C. Standard No. 302.

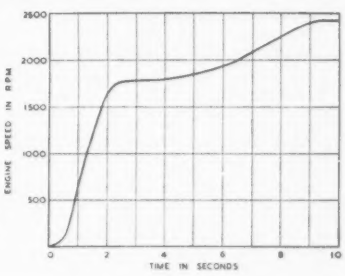
With a torque loading of the magnitude developed by the starter, drive take-up is patently a matter calling for careful design. The starter incorporates a multi-plate clutch between the reduction gear and the output shaft, which effectively caters for the peak loads registered during engagement. Furthermore, an overspeed safety device limits the speed of the turbine assembly in the event of failure of any part of the drive mechanism. Lubrication of the bearings and gear trains is effected by a built-in pump which, served by the main lubrication system of the engine, meters the necessary amount of oil at each start.

One of the difficulties to be overcome with starters of this type is the achievement of reasonable life from the turbine blades for, as may be inferred, the conditions in which they operate are particularly arduous. In this connection, the Plessey Co. state that one such starter under test conditions has had a life test of 750 shots without the replacement of any major component. This represents three times the requirements called for in the official type test.



Typical curve of torque plotted against speed measured at the output shaft.

Typical curve of engine speed plotted against time, and showing acceleration characteristics of the starter.



TWO NEW BOOKS

"Flight Without Formulae," by A. C. Kermode, O.B.E., M.A., F.R.Ae.S., Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London W.C.2, price 18s.

WHEN the first edition of this book appeared in 1940, it was immediately hailed as something for which there had long been a need. In the intervening years there have been five reprintings, and now there comes the second edition. Perhaps it is not without significance that the bulk of the revision work was done by the author while actually in the air—on a flight of nearly 20,000 miles from the Far East to the United Kingdom and back.

As Mr. Kermode says in his preface "when one sits at a desk and writes about flying, one sometimes doubts whether the things that one writes about really do happen, and gazing out of the window brings neither confirmation nor inspiration; but when, sitting in an aeroplane, seeing the clouds rush past—always coming from the front—feeling the extra lift when the flaps go down, gazing at an aileron which remains depressed even when the wings are level, then one writes about flight as it really is, flight without embellishment, flight without formulae." For this second edition, we might well reiterate the comment we made in reviewing the first edition—"Thoroughly good. Can be recommended."

"Tidelines," by Keith Shackleton, Lutterworth Press, 4 Bouverie Street, London E.C.4. price 31s. 6d.

LET it be said at once that *Tidelines* is an enchanting book. Personal taste is, of course, an incalculable thing, but even so, we cannot well imagine anyone other than the most grossly coarse-fibred not finding some measure of delight in these pages. Essentially the book comprises 15 superbly reproduced colour plates of the author's paintings, each of which is accompanied by a short chapter giving the background history of how the painting came to be created; it is but natural that these amplifying notes enhance the appreciation with which one views each picture. Furthermore, if this were not enough, in addition to the colour plates, every page of the book is garnished by beautifully drawn black and white studies.

Of Keith Shackleton's merit as a painter of those subjects closest to his heart there can be little doubt, and it is this unfeigned sincerity of feeling for his subject which gives to his written word a directness of appeal which is almost irresistible. It is no denigration of the author's quality as a writer for it to be suggested that, if *Tidelines* is reprinted or goes to a second edition—as it deservedly merits—the text might with advantage be accorded some polishing revision.

C.B.B-W.

CIVIL AVIATION

NOISE AT LONDON AIRPORT

ON December 13th the Minister of Civil Aviation, Mr. J. S. Maclay, received a deputation representing residents' associations in Harmondsworth, Cranford, Heston and Isleworth and South Harlington. The visitors came to discuss the question of noise near London Airport and of damage said to be caused by vibration to houses in the vicinity. The Minister explained that he was unable to hold out hopes of any change in the policy for the development of the largest international airport in Great Britain, but he did confirm that the extension of London Airport north of the Bath Road would not be started until traffic requirements compelled it, and in any case not before 1954. He also warned the deputation that the number of aircraft using the airport would increase and would include both piston-engined and jet-propelled airliners.

The residents were informed of the work carried out by departmental committees on possible alterations in approach and take-off patterns designed to reduce the noise of aircraft in flight and on possible methods of abating the noise of aircraft undergoing tests during maintenance. Although the first committee had not been able to suggest ways of reducing the noise overhead without affecting operational safety, it was hoped it would be possible to avoid the use of the northerly East-West runway for landings against a westerly wind or for take-offs into an easterly wind; this would have the effect of reducing the amount of flying over the Cranford area in the wind conditions which are most commonly encountered. The second committee, he said, had made exhaustive investigations and carried out some experimental work on acoustic screens. As a result, it was planned to erect a high acoustic wall in No. 1 Maintenance Area; preliminary experiments had given very satisfactory results, but these trials had been of an empirical sort and it was not possible to rely on comparable effects from the full-scale trials.

The question of the effect on houses of vibration from aircraft in flight was also discussed and it was agreed that a joint examination by experts should be made with the object of establishing data agreed on both sides, and from there to proceed to an agreed programme of investigation.

NEW YORK'S HELICOPTER NETWORK

AN extensive passenger helicopter service linking New York airports with 43 points in the States of New York, New Jersey and Connecticut has been approved by the C.A.B. A company known as New York Airways have been authorized to provide services for passengers, mail and general cargo for a period of five years if it can prove itself financially capable of operating for at least a period of six months.

For the first year, however, passengers may be carried only between the three principal airports. The company has not yet decided when the flights will begin or what equipment it will use, but these details will be made known shortly. During a recent public inquiry, conducted to investigate the desirability of the scheme, it was indicated that passenger-fares between the airports would probably amount to about twice the fares now paid on bus routes for the same journeys.

The problem of finding suitable equipment is a serious one, as almost all the American helicopters now in commercial use carry only two or three passengers. The larger-capacity types are at present being produced exclusively for the Services. Although both the Piasecki and Sikorsky companies have suitable commercial projects in hand, it will probably be at least two or three years before such machines are available to operators. Nevertheless, the decision to authorize these services on such a scale undoubtedly represents something of a milestone in civil aviation.

One of the major effects of the plan would be to improve the accessibility of the larger airports in the New York area, which at present are considerably handicapped by traffic congestion in the streets of the city and its suburbs.

VOICE, BRAINS, MECHANISM: In these three photographs are represented the media through which scores of aircraft communicate each day with London Airport. Circuit instructions are passed by the tower operator, seen in the top photograph with his assistant. He acts on information supplied by the approach controllers (centre), who are located in a room immediately beneath the tower operator in the control building. As is implied in the sequence of these pictures, the large number of radio sets required by such a busy terminal are situated on the ground floor.

"Flight" photographs

NICE CONFERENCE ENDS

THE I.A.T.A. Traffic Conference, which ended last week in Nice, has proved to be one of the most significant ever organized by the Association. It was attended by over 100 delegates, representing 40 companies of 30 nationalities, and their main work was to review fares and rates on a world-wide scale. As we have already briefly reported, decisions of far-reaching importance were taken. Full agreement was reached on the introduction of tourist services across the North Atlantic, and these will come into operation next May. They will provide not only cheap fares during the peak season, but even more attractive tariffs during the winter months. The one-way tourist fare from New York to Paris will be $290, with an off-season round-trip fare of $453. Fares to and from other European cities will also be lowered.

Another step of equal significance was the decision taken by carriers to explore the introduction of similar low-rate tourist services within Europe at the earliest practicable date. A subcommittee has been set up to study this problem in detail and will report to the conference in May, 1952. As an earnest of these intentions, and in order to accumulate the fullest experience of high-capacity, low-fare services, the Conference established a number of reduced fares (effective from next October) for Europe's highest-density route, that between London and Paris. Beginning in April 1952, certain special cheap night round-trip fares on services linking Paris with such points as Rome and Madrid will also become operative; some of them will be as much as 42½ per cent. lower than the normal fares. Additionally, during the next summer season there will be special cheap night services between Paris and London and London and the French Riviera; it is not yet possible to disclose the precise fares to be charged.

The carriers represented at Nice have agreed that low fares on tourist services can be made possible only by eliminating some of the more luxurious amenities at present being offered to passengers. Baggage allowances will be less than those for standard services, and in the case of the North Atlantic will be reduced to 20kg. Catering generally will be on a simpler basis and meals will be paid for by the passenger. Considerably more passengers will, of course, be carried in existing aircraft. In the case of B.O.A.C.'s Constellations, seating capacity will be increased to 68 by the addition of 14 removable aisle-seats. As a general rule tourist passengers will not be given free ground transport.

It was agreed, also, to introduce special off-season fares between South Africa and Europe, to show reductions of up to 20 per cent. Other excursion fares at specially low rates were accepted for introduction in South America and in Southern and Central Africa. Carriers showed every wish to keep fares and rates as low as possible, but certain small increases were felt to be necessary in order to meet in part the general trend of rising costs.

Consideration was given during the conference to some of the requirements of smaller regional operators who have their own problems and cannot always accept the same fares and conditions as those applicable to trunk routes and, in the words of Mr. John Brancker, B.O.A.C.'s international affairs manager, "It is indeed a tribute to the spirit of co-operation which exists within I.A.T.A., and to the concern for the public interest that so many contentious points were unanimously resolved."

In conformity with I.A.T.A.'s regulations, the resolutions will be submitted in due course for Government ratification. The next Traffic Conference, incidentally, will be held in the Argentine.

U.S. AND MEXICO TRY AGAIN

REPRESENTATIVES of the United States and Mexican Governments are now trying, for the sixth time, to reach agreement between the two countries on air routes. The head of the C.A.B., Mr. Donald W. Nyrop, is leading the American delegation in the discussions. These have so far been held in "closed-session" and Mr. Nyrop has declined to state whether any progress has yet been made. The opinion in Mexican aviation circles, however, is that it will be a very long time before the two countries will be able to formulate a workable agreement.

Most of the difficulty centres on the fact that both Eastern Air Lines and Compania Mexicana de Aviacion wish to operate to Mexico City and New York. (C.M.A. is actually the Mexican affiliate of P.A.W.A.) The Mexican Government is supporting the C.M.A. proposal while the American Government is backing Eastern. The five attempts which have been made to reach accord since 1945 have all resulted in a complete *impasse*. It is understood also that the route between Mexico City and New Orleans has proved to be one of the major stumbling blocks in what are probably the lengthiest negotiations which have been made to date for the concluding of a bi-lateral air agreement.

AER LINGUS TRAFFIC BOOM

FOLLOWING its recent decision to reduce fares to what is, in fact, the lowest rate for an international air service in the world, Aer Lingus reports the biggest traffic increase on trans-Irish Channel routes since the exceptional expansion period which followed the war. In November the company carried 50 per cent more passengers than in the corresponding period last year, and this trend is said to be continuing. Some routes are showing passenger totals which are twice as great as last year's figures. In November, also, 7,700 passengers travelled on the London route alone, representing a load-factor of 81 per cent. Other routes showed traffic increases ranging from 48 per cent on the Liverpool route to 71 per cent on the Glasgow service. In all, 14,000 passengers used the company's services in November.

The seasonal decline which is normally a feature of winter travel is said to have been substantially eased by the fare reductions. Seventy per cent of the total seating capacity offered by Aer Lingus last month was used, a proportion which is appreciably higher than that recorded even during the early summer.

BREVITIES

THE dollar-earning capacity of B.O.A.C. in the New Year by increasing to a daily frequency the "Bahamian" Stratocruiser service between New York and Nassau which is at present flown three times weekly. Fitted to accommodate 60 passengers, B.O.A.C. Stratocruisers make the flight between these two points in four hours; direct connections can be made at Nassau with services to Montego Bay and Kingston, Jamaica.

* * *

A 43-passenger "coach" version of the French S.O. 30 Bretagne recently carried out a demonstration tour of India, Pakistan and the Far East. In the course of these flights the Bretagne was presented to Indian civil and military aviation authorities.

* * *

On Sunday, December 16th, a Curtiss Commando owned by Miami Airlines crashed in the city of Elizabeth (15 miles from New York) seven minutes after taking off from Newark Airport. Fifty-two passengers and the crew of four lost their lives.

* * *

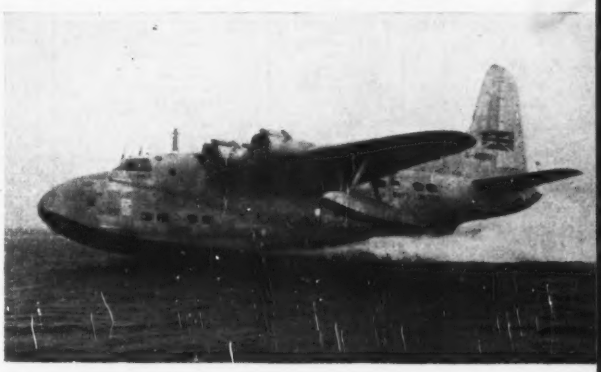
About 450 Australians are due to arrive on Cocos Island this week to intensify work on the airstrip now being built there; they will reinforce a group of 65 men already working on the project. The airstrip at Cocos will form a stopping point on the proposed route which will probably be inaugurated next year between Australia and Africa.

* * *

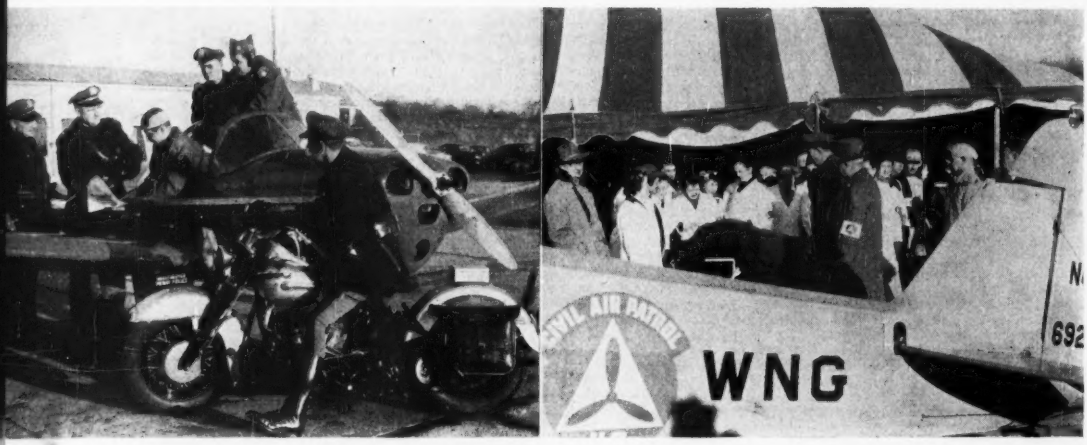
A new British charter company, known as Merchant Airways, Ltd., has been formed with a view to developing industrial charter services and aerial pest-control activities in this country and in Africa. A small aircraft division will be based in England—at Carlisle, Squires Gate and Lympne—and will be using a number of Rapides, Ansons and Austers. The company hopes also to acquire four-engined aircraft. The head office is at Kingstown Airport, Carlisle.

* * *

The Consultative Assembly of the Council of Europe which met recently at Strasbourg has decided to recommend that a single European body be established to operate air routes between member states. The recommendation, which must be approved by the Council's Committee of Ministers, calls for a conference of government experts and representatives of



ACQUIRED BY AQUILA: The Short Solent "Sydney" which was recently purchased by Aquila Airways, Ltd., for use on their Madeira run is seen taking-off from Belfast Lough on its delivery flight to Southampton. The machine, a 42-seater, was an ex-B.O.A.C. boat.



CIVIL AIR FORCE: Recent rumours concerning the possibility of organizing the private flying movement in this country into some form of "Civil Air Defence Corps" recalls the fact that in the United States a similar organization has been in existence for ten years. In these photographs the U.S. Civil Air Patrol is seen in action during Operation "Tri-State," a joint exercise which took place last month in New York, New Jersey and Pennsylvania. War duties of the C.A.P. would include co-operating with police forces and municipal authorities, rendering assistance in the evacuation of casualties and message and supply-dropping.

CIVIL AVIATION . . .

European airlines to study the possibility of forming such a body. This committee would also report to the assembly on other possible means of achieving closer co-operation in air transport.

* * *

For the first time in its history, Swissair has exceeded the figure of 10,000,000 aircraft-kilometres flown in one year. In view of the relatively small size of Swissair's fleet and of its aircrew strength, the achievement is one which indicates an exceptionally high utilization in both cases.

* * *

In October B.O.A.C. achieved an operating profit of £104,000 which, after allowing for interest on stock, left an overall surplus of £7,000. These figures can be compared with an overall deficit of £231,000, and an operating loss of £89,000, in October, 1950.

In the seven months from April to October of this year, the Corporation made an operating profit of £1,078,000 and an overall surplus of £140,000, as compared with an operating loss of £1,513,000 and an overall loss of £2,459,000 for the corresponding period of last year.

* * *

In a move to end the current strike of Pan-American World Airways' 4,000 ground and servicing personnel, President Truman last week appointed a three-man committee to investigate the dispute and report back to him in 30 days. It will not begin its investigations, however, until the strikers have returned to work. A U.S. Government spokesman has said that the strike will seriously affect the Korean airlift, in which P.A.W.A. plays a major part. When stewards and stewardesses joined the strikers last week, some of Pan-American's office-workers in London were asked to fly in these capacities on long-distance flights.

R.Ae.C. AVIATORS' CERTIFICATES

WE publish below another of the periodical lists of those who have qualified for R.Ae.C. Aviators' Certificates; it covers the period from October 29th to November 30th. The previous list (October 4th to 29th) appeared in *Flight* for November 23rd.

No.	Name	Club or School	Date
27,711	M. B. Smith	Qualified Service pilot	29.10.51
27,712	S. F. Berry	Qualified Service pilot	29.10.51
27,713	D. I. Weekes	R.A.F. Cottesmore	29.10.51
27,714	B. J. Weaver	Coventry Aeroplane Club	30.10.51
27,715	K. Henley	Qualified Service pilot	1.11.51
27,716	W. H. Harris	Qualified Service pilot	1.11.51
27,717	A. R. Dokumbilek	Herts and Essex Aero Club	1.11.51
27,718	J. F. Grimsey	London Aeroplane Club	1.11.51
27,719	W. G. Wright	R.A.F. Cottesmore	1.11.51
27,720	D. C. Burbridge	R.A.F. Cottesmore	2.11.51
27,721	P. O. Readstone	Cheltenham Aero Club	6.11.51
27,722	J. F. Williams	Wolverhampton Aero Club	6.11.51
27,723	J. G. Glyde	Kuala Lumpur Flying Club	6.11.51
27,724	R. E. Marsh	Luton Flying Club	6.11.51
27,725	G. D. Rimmer	Fair Oaks Aero Club	6.11.51
27,726	D. G. McDowall	Strathtay Aero Club	9.11.51
27,727	P. Mathers	West Riding Aviation Centre	6.11.51
27,728	P. E. Sundt	Portsmoth Aero Club	6.11.51
27,729	M. S. R. Boult	West Riding Aviation Centre	6.11.51
27,730	D. R. Wells	Qualified Service pilot	6.11.51
27,731	C. P. Blackham	Qualified Service pilot	6.11.51
27,732	W. W. Cree	R.A.F. Syerston	6.11.51
27,733	R. H. Andrews	R.A.F. Syerston	6.11.51
27,734	R. E. Johnson	R.A.F. Syerston	6.11.51
27,735	D. L. Pratt	Marshall's Flying School	6.11.51
27,736	C. J. Longworth	West London Aero Club	9.11.51
27,737	J. T. Hayes	Boston Aero Club	9.11.51
27,738	R. A. F. Wright	Bembridge and Sandown Aero Club	9.11.51
27,739	D. L. Pollard	London Aeroplane Club	9.11.51
27,740	B. Hopkins	Midland Aero Club	9.11.51
27,741	A. M. Harris	Midland Aero Club	9.11.51
27,742	D. C. E. England	Oxford Aeroplane Club	10.11.51
27,743	M. J. King	R.A.F. Cottesmore	9.11.51
27,744	M. J. Fowler	R.A.F. Syerston	9.11.51
27,745	B. Ward-Hersee	Airways Aero Club	10.11.51
27,746	J. Arthur	Coventry Aero Club	12.11.51
27,747	R. F. Byrne	Strathtay Aero Club	12.11.51
27,748	I. S. J. Lewis	Cardiff Ultra-Light Aeroplane Club	12.11.51
27,749	D. W. J. Gumbrell	Luton Flying Club	12.11.51
27,750	H. S. Jones	Cardiff Aero Club	12.11.51
27,751	E. J. Howard	Herts and Essex Aero Club	12.11.51
27,752	S. G. Bedford	Qualified Service pilot	12.11.51
27,753	W. J. Dobson	R.A.F. Cottesmore	12.11.51
27,754	D. G. Tayler	Qualified Service pilot	12.11.51
27,755	C. V. Ogden	Qualified Service Pilot	12.11.51
27,756	B. E. Harding	Southend Flying School	14.11.51
27,757	D. F. Cook	Qualified Service pilot	16.11.51
27,758	A. S. Ryde	R.A.F. Cottesmore	16.11.51
27,759	G. G. King	Airways Aero Club	19.11.51
27,760	M. St. J. Shortt	Portsmouth Aero Club	22.11.51
27,761	H. Wigley	Qualified Service pilot	22.11.51
27,762	V. E. R. Booth	Qualified Service pilot	22.11.51
27,763	B. V. Akerman	West London Aero Club	22.11.51
27,764	J. Boyce	Hampshire Aeroplance Club	22.11.51
27,765	J. L. Seaby	Qualified Service pilot	22.11.51
27,766	D. Davidson	Cardiff Ultra-Light Aeroplane Club	22.11.51
27,767	G. T. Thomas	Qualified Service pilot	22.11.51
27,768	P. G. Embrey	R.A.F. Cottesmore	22.11.51
27,769	A. Robson	Qualified Service pilot	22.11.51
27,770	I. Yavneh	Qualified Service pilot	22.11.51
27,771	I. D. Pattinson	R.A.F. Cottesmore	22.11.51
27,772	R. D. Hillary	Qualified Service pilot	22.11.51
27,773	R. J. R. Trefusis	R. N. Flying Club	27.11.51
27,774	W. Keith	Qualified Service pilot	27.11.51
27,775	P. J. Deary	R.A.F. Cottesmore	27.11.51
27,776	F. J. Law-Smith	Flying Club of Northern Rhodesia	27.11.51
27,777	A. R. Edwards	Wolverhampton Aero Club	30.11.51
27,778	J. Lewtas	Tees-Side Flying Club	30.11.51
27,779	P. J. Faid	Strathtay Aero Club	30.11.51
27,780	G. D. Myers	R.A.F. Cottesmore	30.11.51
27,781	J. M. Ilsley	R.A.F. Cottesmore	30.11.51
27,782	J. T. Reynolds	R.A.F. Cottesmore	30.11.51

THE CASE for the ULTRA-LIGHT

A Plea for a New Approach to the Problem of Everyman's Aircraft

By J. H. W. WHEATLEY

GEORGE BERNARD SHAW poked much of his wit at the British acceptance of authority and tradition. He examined the structure and purpose of social convention, Christianity and the medical profession.

He might well have included the aircraft industry.

The international reputation in aeronautics established by this country in the last generation appears to satisfy the taxpayer—which, perhaps, is why so little interest or inquiry has been made into the existence, health and future of the ultra-light and personal types of aircraft. The novelty of the jet and the luxury of the airliner have brought the fantasies of Wells to reality, and are probably responsible for diverting the attention of the layman, and of people in the Industry itself, from the sad absence of the "babies."

In recent years the S.B.A.C. Shows have been attended by a growing public with a relish reminiscent of the Cup Final; and Shaw, were he now alive, would surely anathematize this steadily growing tendency "to pay your money and watch the other fellow." There still seems to exist, in the hearts of all but the enthusiasts, the old belief, that private flying has been, and always will be, the privilege of the fortunate few who can afford the time and the money.

The present competitive rush in the realms of advanced design disguises an ironical situation in the industry. In spite of the knowledge and experience available, there has been no serious attempt, since the Chilton was conceived and built thirteen years ago, to fill the gap between the local meadow and Heathrow.

In contrast, visitors to the Motor and Motor Cycle Shows annually share the pleasure of viewing the latest and best in the world and have the satisfaction of being able to choose and own a machine specifically designed for their own needs and pockets. The red flag was abolished from the roads nearly fifty years ago, but it still flies in aeronautics—from a string of excuses. Maybe it is unfair to draw a direct comparison between road and air, for there is no denying the difficulties and problems that will have to be overcome, and the existence of prejudices that must find their way into the dustbin if the sky is to be utilized.

What of the discussions, the correspondence and the plans for the future? No word in the newspapers or from the House of Commons. Little hope or encouragement was forthcoming from any firm or authority until the other week, when a faint official smile was released upon "business-house" flying clubs, in the form of a renewal of subsidised flying hours. Lord Leathers now hints at the future participation of private enterprise in civil aviation. But this new focus serves only to illuminate the deplorable lack of safe, cheap and efficient aircraft.

Hit-or-miss Designing

It may be necessary to point out the blunt fact that there have been precious few systematic designs in the ultra-light classes. Past progress has been left to enthusiastic amateurs who struggled to produce machines that just scraped the linings of the official requirements. Most of them managed to get around quite satisfactorily and some, fortunately, flew very well; but the hit-or-miss method was never satisfactory and evidence of this is available to anyone who cares to compare respective plots of the aerodynamic parameters for the light and advanced types.

Admittedly, the attitude and approach required for the successful creation of the new ultra-light is a long way removed from the present high-pressure techniques; but the project work and the problems involved must be tackled with a similar thoroughness and finesse. There is, alas, an inclination among aircraft technicians to dismiss the whole ultra-light conception as "kid's stuff." We are getting too grown-up to tie our own shoes.

Little is ever achieved by fanaticism or vague bureaucratic pronouncements. What is required is a combined effort and the sinking of individual differences by all concerned. Mutual discussion between the civil, legal and aeronautical authorities is essential if the ground is to be cleared for the solution of such problems as safety, inspection, flight clearance and the licensing of pilots and machines with the minimum of cost and red tape.

The first job is vital, and on it rests the success of the outcome. Rigid but practical specifications must be agreed upon for single- and two-seater aircraft for operation from normal-sized grass fields. In this connection it would be interesting to know if any of the neglected war-time satellite airfields that still litter the country could be reclaimed to provide adequate amenities for week-enders—or, for that matter, permanent hangarage.

If and when the constructors are aroused and sufficient backing is promised by the Ministry of Civil Aviation it will be necessary to start with a clean sheet and a clear mind. The combination of design and research experience will need careful handling to produce an aircraft as near the original specifications as is humanly possible. Much tolerance, for instance, will be needed to win over the many disbelievers born of the disastrous era of the pre-war "Flying Flea."

But are the difficulties as acute as some would have us believe? A sense of safety would destroy the greatest bogey in flying. The only sure way to achieve it is by example and the establishment of a healthy history. The difficulty is that, in the eye of the beholder, one fatality can neutralize a thousand happy and successful flights. The slaughtering of thousands of people on our roads in six years of peace does not seem to condemn motor traffic; yet is it realized that aircraft landing speeds below the present road limit in built-up areas were common, even in the slap-happy days of design? The dangers from stalling and spinning could be lessened, if it were accepted that there is no particular aeronautical sin in designing for a little more stability and a little less manœuvrability.

Materials and Labour

The cost and availability of material is another thorn of the rose. Fundamentally, there is much less metal and machinery in a well-designed ultra-light than in the average 10 h.p. car; in fact, the weight of the car is equal to that of two aircraft. Presumably, with the promise of moderate mass-production, the overall cost would be reduced in a similar proportion. Labour costs add to the agony, but would be less important if the aircraft were designed to be sold in kit form. Test-flying troubles, and clearance for the owner-assembled aircraft, could be reduced by painstaking and simple design. The use of plastics for the profiles of control surfaces would be a justified expense.

Finally, the power unit. Converted car engines are all very well for experimental purposes, but there is no real counterpart to the rare and expensive Walter Mikron. What is needed is an engine designed, with all its accessories, for the sole purpose of providing a small, cheap and reliable source of aircraft power. The 35-75 h.p. class of engine deserves further investigation, even though the purists point to irrelevancies like mechanical efficiencies and airscrew inefficiencies.

S/L. Porteus assures us, when referring to his Chilton, that the operating costs compare favourably with those of an 8 h.p. Morris. The Chilton points the way, and no better proof of this was its lead over the rest of the field by eight easy minutes in the South Coast Air Race this year.

The benefits of these machines are obvious. Once learned, flying is like swimming—it is never forgotten; and experience gained in sports coat and flannels has only to mature in uniform. An enthusiastic and well-trained nucleus of airmen would be invaluable if ever we should find ourselves at war.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

That Tax Concession

I HAVE read about the Government's concession to companies whose welfare organizations may want to form a flying club, but so far I have not heard anybody either talk about it or show any enthusiasm for the arrangement, and I feel sure this must be because they have not realized what it all means.

I had thought that the chaps in a factory would get together and tell the welfare or sports officer that they wanted to form a flying club, but things don't happen this way, and it now occurs to me that what should happen first is that every go-ahead flying club should make a list of all the companies within a reasonable distance of its airfield and write to them—pester them, even—so that the companies know what the flying club can offer. After all, not many works managements can be expected to know much about flying instruction, but the clubs know exactly what ought to be offered to the boys in the works. If anything, the clubs stand to get more out of the Government's offer than the individual, and I suppose the intention of the concession was as much to keep the club organizations going strong in case they should be needed in an emergency as it was to produce men—and, for that matter, women—able to fly.

Having got this concession out of the Government and a refund on petrol tax as well, it ought to be possible to get some cheap private flying. If people don't get a move on, I suggest that it is *Flight's* job to chivvy them up. The English are slow to enthuse, but there is no beating them once they get moving. Of course, the next thing is to decide what to do about the chaps who live and work miles from the nearest flying club.

Rhyl, North Wales. G. EVANS.

Rearward-facing Seats

HAVING jumbled my arguments together, quoted them out of context (or misquoted them, as his fancy pleases), and descended to verbal slapstick, which seems singularly inappropriate from one writing in the learned and dignified atmosphere of Magdalen College, Mr. Brian J. Haimes (December 14th) challenges me to "recommend (with facts and figures) a clear-cut policy on which action can be taken" to convince him (and, I suppose, airline operators) of the necessity and practicability of rearward seats.

Well! To undertake the task Mr. Haimes sets would take several pages of *Flight* and, while I am quite prepared to do this (at the usual rates or otherwise), I doubt whether the Editor is, as he has already devoted much space to this subject both in editorial and feature articles as well as in the correspondence columns.

However, if permitted, I will try to straighten out the more obvious misconceptions, misunderstandings and mis-statements of Mr. Haimes' letter :—

Point 1. I certainly said nothing about *fixing* seats to the floor, forward-facing or the reverse. Not thinking Mr. Haimes expected me to cater for Grade I intelligences in such a journal as your own, it never occurred to me, I must admit, that anyone would visualize anything so primitive or unsafe as seats which were *not* firmly fixed into place, whichever way they faced!

Point 2. Mr. Haimes still inveighs against my "generalizing" from particular cases and asks for more proof. My reply to this is that most of the outstanding accidents recently reported in which there was any hope of survival at all—i.e., as distinct from instantaneous total fire; disintegration; structural failure; collision; or ditching—indicate that passengers have more hope of survival in rearward seats. I cannot list every accident which has occurred in, say, the past 10 years, but I believe, from reading published reports, that the cases I quoted represent a fair proportion and fair examples of the type of accident under discussion; and I am confident that if some unbiased adjudicator were to publish details of all such accidents, the case for rearward seats would soon be established.

Point 3. Here Mr. Haimes remarks that where rearward seats part from the floor they would only be (of) useful (value) in circumstances where one is in little danger anyway. Since he is so anxious for facts and figures and so suspicious of generalizations perhaps he will produce the evidence upon which this particular generalization of his own is founded?

Point 3 (2). I am alleged to have said that "proper padding will meet the case"—a misrepresentation, in this context, apparently, of the credit I was at pains to give Mr. Tye's expert opinion that, with forward seats, casualites could equally well be reduced by padding or redesigning objects and structure in front of the passenger, so that they caused him less damage when thrown on to them in a crash. The fact, however, that I also added it would still be safer, in my opinion, to use rearward seats, and possibly more economical so to do, does not discourage Mr. Haimes from saying this takes the wind out of the (sails for the) case for rearward seats.

Point 3 (3). Mr. Haimes evidently cannot visualize turning seats round and re-fixing them in their new position—this is a "t" which apparently also has to be crossed for him, fond though he seems of crossing the "t"s (and the swords) of others.

Point 4. Here Mr. Haimes begins to grasp that I possibly do believe in fixing seats in aircraft (though I have still to say *ça va sans dire* apparently) and is prepared to accept Mr. Tye as an authority. We progress. I am taken to task, however, for giving various estimates of the g figures thought necessary (or used in practice) for rearward seats without saying which I myself recommend. I do not feel, however, I need justify such modesty. All I did was to point out that rearward seats already exist, and are used, of a folding or light occasional type; and that their strength is comparable with that of ordinary seats, and virtually within even the most extreme limits as those commonly picked out as necessary for rearward seats. (Why not for forward ones also? I cannot say—ask Mr. Haimes why; the weights and stresses being the same mass either way.) I also pointed out that the more usual figures given by Mr. Tye for crash loads were well within the capability of such existing types of rearward seats. Does this not answer Mr. Haimes' objections on this point?

Point 5. The main criticisms Mr. Haimes makes under this heading merely reiterate those I have already answered, so no further reply is needed to them.

Mr. Haimes' suggestion that M.C.A. or R.A.E. should test the advantages or otherwise of rearward seats, on the other hand, is sound, constructive sense—but he is as capable of writing to his M.P. as I (and as the originator of the idea has prior claim to do so). In any case, for all I know this has, in fact, been done, and successfully, as all Service equipment is presumably properly tested.

It is strange that after all his objections Mr. Haimes concedes that mine is probably the right answer, only to read me a homily on consistency and principles. As for this, I think I may claim to have consistently stuck to my general principles in the many letters I have written on this subject.

East Twickenham, Middlesex. D. HORNSEY.

[We feel that we have now given this matter a very good airing indeed, and unless we receive any authoritative opinions which throw altogether new light on the subject we do not propose to publish any further letters upon it. If F/L. Hornsey and Mr. Haimes, like Tweedledum and Tweedledee, wish to continue their battle in private, we shall be delighted to put them in direct touch with each other.—ED.]

Lesson from America

SOME few weeks ago, your leader-writer quoted some of the lessons which the British aircraft industry can learn from the experimental findings and practices at Convair. I was particularly impressed by this for, in my patriotic blindness, I had always happily thought that, so far as marine aircraft were concerned, this country had nothing to learn from anybody. Now, apparently, if what Convair says is true, it seems as though the U.S. are forging ahead in this field as well as others. But then, from what I have gathered from *Flight* over the last few years, nobody in this country has much interest left in the flying boat anyway. I suppose if the Princesses were American-built, B.O.A.C. would be falling over themselves to buy them.

I must confess to being ignorant of the technical niceties of "free-body dynamically-similar models," but I can understand the apparent advantages of their use. Is this, too, a field in which the Americans are showing the way, or are firms in this country making use of the technique?

London S.W.5. J. HUNTER.

[As mentioned in our leader of November 16th, the dynamically-similar model technique was initiated in this country, and Convair have developed that technique to their own uses. Although models are used by British aircraft manufacturers, none, so far as we are aware, has carried the principle to the extent exploited by Convair. We hope, however, that this situation will be rectified.—ED.]

SERVICE AVIATION

Royal Air Force and Naval Aviation News

"Flight" photograph

REVIEWING OFFICER: Marshal of the R.A.F. Sir John Slessor taking the salute at the Halton passing-out parade last week. With him on the dais were Air Marshal Sir John Whitworth Jones, A.V-M. R. O. Jones, A. Cdre. J. G. Elton, G/C. D. O. Finlay and W/C. Viscount Acheson.

Airfields and R.A.F. Expansion

SPEAKING at the annual dinner of the R.A.F. Airfield Construction Officers' Association, Marshal of the Royal Air Force Sir John Slessor described the problem of airfields as "one of the major headaches" in the expansion of the R.A.F. and the air forces of the North Atlantic Treaty Organization countries. "If we are to operate 10,000 first-line aircraft," he added, "that means a hell of a lot of airfields."

Sir John then went on to point out that an airfield today costs more than a battleship did before the First World War and that the cost to the Western Allies in operating a force of this size will be very great.

"What is worrying us," he continued, "is how we are to know whether we shall be able to operate the new airfields we start with. We have got to solve this problem of taking off and landing, or it is going to bog us down and make us immobile." A flying-boat fighter, he thought, should have been developed long ago; but it was of little use to develop such a fighter now.

Sir John concluded by telling his listeners that one of the best services airfield construction officers could perform for the R.A.F. and the Western Allies was to try to think out how they could reduce the appalling cost, in men and materials, of airfields today.

Halton Graduation Parade

THE Chief of the Air Staff was also the reviewing officer at the graduation parade of the 61st Entry at No. 1 School of Technical Training at Halton. Ninety-eight aircraft apprentices finally qualified in this entry.

A. Cdre. J. G. Elton, the School Commandant, in his address to the apprentices and guests, pointed out that no fewer than 4,000 apprentices, about 25 per cent of the total number, had been awarded commissions in the R.A.F. Of the outgoing Entry, he said that the average technical standard in all trades was the highest obtained since the introduction of the new trade structure. Airframe fitters had reached the high average of 86 per cent.

In educational subjects 11 per cent had obtained "A" passes, which was the standard required for a permanent commission, and 86 per cent had reached "B" standard.

A feature of the course had been visits to R.A.F. stations and aircraft manufacturing concerns. During a visit to the Martin Baker Aircraft Co., each armament apprentice had made a practice "ejection" on one of the firm's ejector seats at an acceleration equal to 12g.

During the time he was at Halton each apprentice was given, on an average, air experience totalling 3 hr 5 min, and five boys had been awarded R.Ae.C. gliding certificates.

Prizewinners of the term were: Monsignor Beauchamp Memorial Prize, F/S. App. G. F. Poyser; Crebbin-Robinson Cup, L/App. E. M. Drake; Elliott Memorial Prize, Sgt/App. R. Greenwood. *Air Ministry Prizes:* Highest in all subjects F/S. App. G. F. Poyser; highest in educational subjects: (1) Sgt./App. G. D. Adamson, (2) Cpl/App. A. Sherring; highest in general service efficiency: (1) Sgt/App. G. F. Poyser, (2) Sgt/App. R. Greenwood; highest average for practical fitting over three-year course, F/S. App. G. F. Poyser. *Best Tradesmen in Trade Standards Trade Test:* Airframe Fitter, Cpl/App. P. L. Wort; Armament Fitter, L/App. D. C. King; Electrical Fitter (Air), Cpl/App. D. C. Johns; Electrical Fitter (Ground), Cpl./App. S. P. Bristow; Engine Fitter, F/S. App. G. F. Poyser; Instrument Fitter (Nav.), S/App. G. D. Adamson; Instrument Fitter (Gen.), L/App. J. A. V. Jinman.

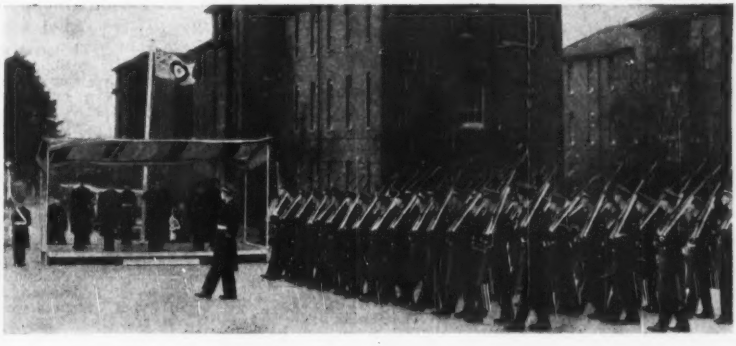
Empire Air Memorial

WORK on the memorial to the memory of over 20,000 Commonwealth airmen who lost their lives while serving in Britain and North-west Europe during the last war has started at Cooper's Hill, overlooking Runnymede, near Windsor.

The site, which covers some seven acres, was given by Sir Eugen and Lady Effie Millington-Drake, and Edward Maufe, R.A., has designed the memorial. Entrance-gates at the southern end will open to a central avenue of silver birches leading to the shrine and cloisters. The shrine will have a central arched opening with, above, three figures respectively symbolizing justice, victory and courage. Two spiral staircases will lead to a gallery above the shrine and a further staircase will give access to the roof, on which it is

IN SLOW TIME: The Senior Entry marching past the saluting base during the passing-out parade of No. 61 Entry at Halton. On the left is F/S. App. G. F. Poyser, who took no fewer than four prizes and was also awarded a cadetship at R.A.F. College, Cranwell.

"Flight" photograph



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proposed to provide directional signs pointing to various Dominion centres.

The airmen's names will be inscribed on the stone reveals surrounding the narrow windows of the cloisters; the light falling on these reveals will give them the appearance of partially opened stone books. Badges of all the squadrons to which the airmen belonged will be incorporated in the ceilings of the cloisters.

Construction should be completed by the end of 1952, and the ceremony of dedication will be held during the following spring.

Three other air force memorials are to be erected by the Imperial War Graves Commission. One to commemorate those who lost their lives in the central and western Mediterranean area is to be built on a site not yet selected on the George Cross island of Malta; the Middle East and eastern Mediterranean memorial is to be at El Alamein; and one in the Far East will be on Singapore island.

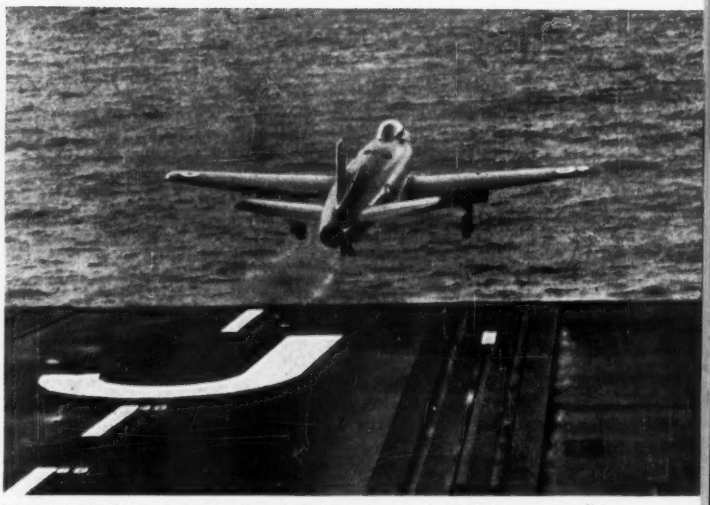
Commonwealth Air Conference

AT the Commonwealth Air Forces Conference, held at the Air Ministry, London, this month, the following officers represented their respective countries: *Australia*, A.V-M. V. E. Hancock (Deputy Chief of Staff) and G/C. C. D. Candy; *Canada*, A. Cdre. M. Costello (Air Member, Canadian Joint Staff, London); *New Zealand*, A.V-M. D. V. Carnegie (Chief of Air Staff) and W/C. T. F. Gill; *South Africa*, Brig. H. C. Willmott (Air Chief of Staff) and Maj. C. G. van Pittius; *Southern Rhodesia*, Lt. Col. E. W. S. Jacklin (O.C.S. Rhodesian Air Force) and Lt. Col. T. Jordan. A.V-M. D. Macfadyen, R.A.F., Assistant Chief of the Air Staff (Policy), was the chairman.

On December 12th the Air Council gave a dinner to the visiting officers. The guests were received by Lord De L'Isle and Dudley, V.C., the Secretary of State for Air.

"Flight" photograph

OPS ONE: W/C. R. T. P. Davidson, D.F.C., R.C.A.F., who is the operations officer (wing commander flying) at the Canadian air base in Britain at North Luffenham.



WITHOUT CATAPULT: An Attacker from No. 703 Squadron, Service Trial Unit, makes the first jet take-off from the flight deck of H.M.S. "Eagle."

Director of Auxiliaries

THE first appointment to head the new Directorate of Auxiliaries, Reserves and Air Cadets, which has been set up to advise the Air Council on matters affecting these forces, has been made to A.V-M. W. M. Yool, C.B., C.B.E. He will be assisted by G/C. I. B. Newbiggin, D.F.C., as Deputy Director and by the Inspector of the R.Aux.A.F. This last appointment is at present vacant, A. Cdre. Finlay Crerar, O.B.E., having completed his tour of duty.

A.V-M. Yool retired from the R.A.F. in June, 1949, on the termination of his appointment as A.O.A. Mediterranean and Middle East Command. He was chairman of the R.A.F. Display committee which organized the highly successful air show at Farnborough last year.

R.A.F. Appointments

AFTER serving for a year as S.T.S.O. at H.Q. Coastal Command, A. Cdre. A. F. Hutton, C.B.E., D.F.C., is leaving to become A.O.C. No. 43 Group, Maintenance Command. He succeeds A. Cdre. H. H. Chapman, who is to be Director of Signals (Policy) at the Air Ministry from January 15th.

The new S.T.S.O. at Coastal Command will be A. Cdre. D. W. R. Ryley, C.B.E., who is at present Commandant of the R.A.F. Technical College at Henlow, Bedfordshire.

C.F.S. Association

NEXT year, Central Flying School, R.A.F., completes 40 years continuous service as a unit, and it had been decided to form a C.F.S. Association with the object of strengthening the links between past and present members and to simplify the keeping of the C.F.S. register. It will, it is thought, also enable the annual reunion dinner to be put on a sound financial footing and safeguard the sale and wearing of the C.F.S. tie.

Full membership of the association is restricted to past and present officers who have served for at least six months on the permanent strength of the Central Flying School since 1912; Gosport School of Special Flying; Empire Central Flying School; and No. 7 F.I.S., Upavon, from March 1942 until the re-forming of C.F.S. proper in 1946. Non-commissioned and warrant officer instructors on the posted strength of these schools for six months and who have subsequently been commissioned are also eligible. The subscription has been fixed at three guineas for life membership or five shillings annually.

Ex-members wishing to join the new association should write to the honorary secretary at R.A.F., Little Rissington, Gloucester.

New C.O. for Halton

AFTER serving as Director of Policy (Air Staff) at the Air Ministry for the past two years, A. Cdre. J. G. W. Weston, C.B., O.B.E., is appointed to command No. 1 School of Technical Training at Halton.

In addition to the time spent at the Air Ministry, A. Cdre. Weston has, since the end of the war, spent a year at the Imperial Defence College and commanded the Radio Warfare Unit, which later developed into the Central Signals Establishment.

Canal Zone Repatriations

IN the air and sea repatriation of R.A.F. families from the Canal Zone, Transport Command brought home 586 families in 62 round trips by Hastings aircraft.

At the peak of the operation, which involved 311,850 air miles flying, six Hastings left Fayid each day.

Lees Trophy Winners

RYDE, Isle of Wight, A.T.C. Squadron (No. 1024) has won the Lees Trophy for 1951. Worcester (No. 187) came second and third place was awarded to Battersea (No. 33F). A letter of congratulation from Air Marshal Hardman, A.O.C.-in-C. Home Command, was received by F/L. R. B. Stratton, who commands the winning unit.

Weston Resistance Bulbs

The Model S.110 Platinum Resistance Bulb, used in conjunction with a Weston circular scale indicator is greatly superior in every respect to other methods of temperature measurement. Its platinum element is the most stable, accurate and the smallest yet produced for practical applications. Due to the very small size of the resistance element, the response time is extremely rapid. Reliability and long life are ensured by the fact that the element is hermetically sealed into a ¼" o/dia. stainless steel sheath which is fitted with a watertight cable connection.
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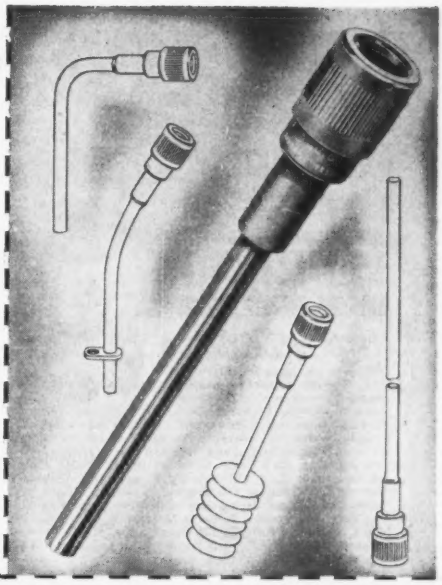

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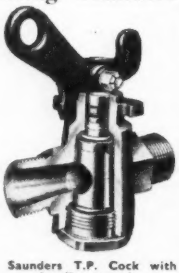

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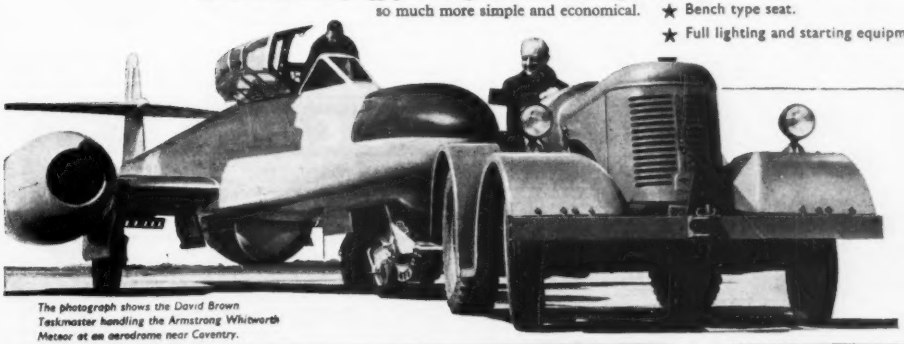

The photograph shows the David Brown Taskmaster handling the Armstrong Whitworth Meteor at an aerodrome near Coventry.

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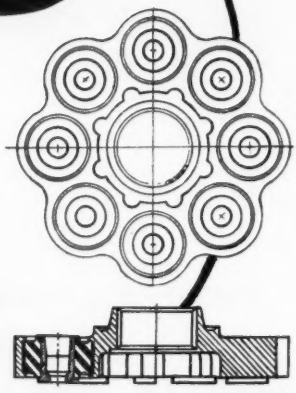

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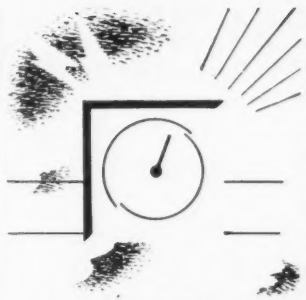

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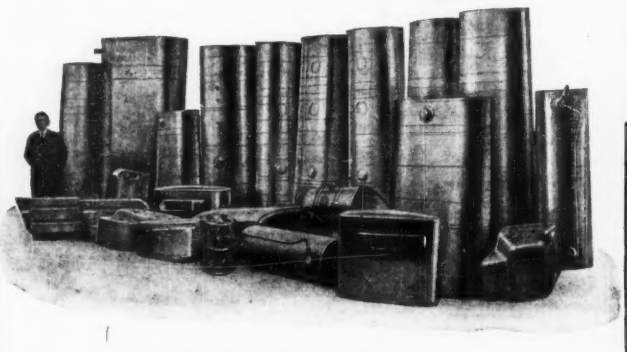

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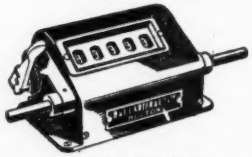

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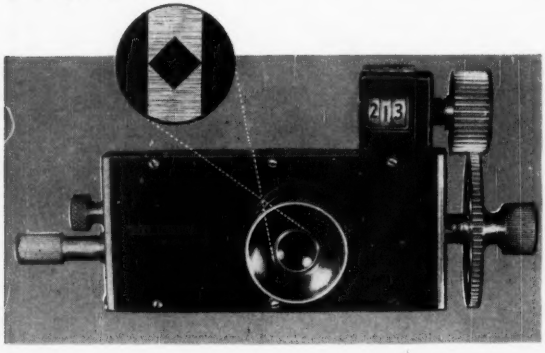

On the instrument illustrated on the left, the hardness is measured by rotating the knurled spindle on the right, until the image of the indentation (see inset) exactly fits between two parallel faces. The number on the counter is then referred to a chart, from which the Vickers Hardness Number is found. This, in the example shown, is 204.

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